A Formative Evaluation of Valle Grande Rural Institute in Cañete, Peru

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The purpose of this paper was to appraise the quality of recommended cotton fertilization practices Valle Grande Rural Institute, a nongovernmental organization in Cañete, Peru. In addition, the researchers examined Cañete's low resource farmers' ability to incorporate two alternative cash crops (grape and asparagus) into their livelihood system. It has been documented that much of the on-experiment station agronomic research in developing countries has very limited generalizabiltiy to low resource farmers. A data set of 622 cotton production records were used in the development of production functions (regression equations) that examined the relationship between lint production and fertilization inputs. An environmental index was included in these analyses to control for biophysical and socioeconomic conditions. Linear programming was used to determine the low resource farmers' ability to adopt the alternative cash crops. Data for the linear programming model were collected from a Sondeo (n=22), personal interview survey (n=60), and selected secondary sources. During the seven year period that fertilization practices were examined, nitrogen and phosphorous contributed to production in only three of the seven zones. Both only contributed positively to cotton production in one of the three zones. Based upon the results of the linear programming model, these low resource farmers did not have the inputs necessary for grape production. Only 40% of the farmers would be capable of producing asparagus.

Introduction & Theoretical Framework

Agricultural extension is more than "interventology" (Roling, 1990, p. 12). Agricultural extension is "the business of facilitating learning, of helping people usefully to construct effective action in the domain of existence" (Roling, 1998). Successful programming is farmer-centered and involves an extensionist who assumes the role of facilitator, learner, and consultant. As a result, ours is a discipline that is primarily concerned with social learning (Roling, 1998).

Formative evaluations of agricultural extension programs in developing countries are essential. Two major factors contribute to the need for formative evaluations. First, much of the on-station research, which results in approved practices, has limited generalizability beyond the agricultural experiment stations (Hildebrand & Russell, 1996). Secondly, often practices are a result of research or indigenous knowledge conducted exclusively on-farm, and may suffer credibility that limits broader adoption (Baker, Koyama & Hildebrand, 1999; Baker, Araujo & Hildebrand, 1998).

Small, limited resource farming communities are highly elaborate systems. A comprehensive analysis of a livelihood system includes land, labor, and capital requirements for sustaining the household. Household composition, gender–related responsibilities, off-farm or non-farm activities, land ownership, credit availability, marketing information, and production seasons and cycles all directly or indirectly impact crop and animal agro-systems, which impact households (Rocheleau, 1987; McDowell & Hildebrand, 1986; Cabrera, 1999; Sullivan, 1999).

Background Information

The Cañete Valley is located on the central coast of Peru. It consists of 22,600 ha of agricultural land, and its elevation varies from 0 to 700 meters. The life of this desert-like valley is the Cañete River, which flows continuously throughout the year. The temperature varies from 12/ C in the winter to 32/ C in the summer. There are 152,379 valley residents, with an average annual income of US$1,420 per household. There are seven individuals per household.

Valle Grande Rural Institute (VGRI) is a non-governmental organization (NGO) that has been in existence for more than 30 years, promoting rural improvement through extension and education programs designed for low income farmers. VGRI reaches more than 1,000 small farmers in different programs annually. The operating budget of VGRI comes from different sources; approximately one-third of it is from local resources (services have a minimum charge), another one-third is raised through local and national donations, and the additional funds are provided from international institutions. The VGRI has a target population of 4,800 small farmers with 12 ha or less.

VGRI currently operates a coastal extension office, a mountain extension office, an entrepreneurial development office, a soils laboratory, and an agricultural college. With the exception of the mountain extension office, the offices, laboratory, and college collaborate in serving the needs of the Cañete Valley farmers.

Purpose and Objectives

The overall purpose of this study was to appraise the quality of selected recommended agricultural practices of VGRI. The specific objectives of the study were to:

1. assess the validity of VGRI recommended fertilization practices for cotton production; and
2. determine the capability of limited resource farmers to adopt grape and asparagus enterprises that had been recommended by VGRI in previous years.

Methodology

The population and sample differed based upon the multiple data collection methods used by the researchers. Production functions were utilized to assess the approved practices for cotton fertilization. Small farmers who borrowed money through the VGRI between 1992 and 1998 (N= 1,860) served as the population. A purposeful sample (n= 622) consisting of farmers with complete records was used to develop the production functions. The dependent variable was cotton yield per ha in quintals (100 lb.). The independent variables in the regression models were nitrogen in kilograms (N), phosphorus in kilograms (P), potassium in kilograms (K), annual environmental index (average production per ha for the specific year in quintals – EI), and the following interactions (EI x N, EI x P, EI x K).

The EI is the result of calculating the average of all available production data for each year. In 1996, Hildebrand and Russell indicated that an environment includes both biophysical and socioeconomic factors. Broadly speaking, environments can be classified by farm type, nature of the farm household, climate, soils, farmer management, and others (i.e. agro-ecological zone or by commonly reoccurring pests). Production functions were calculated for seven unique agro-ecological zones within the Cañete Valley (Figure 1).

The annual environmental conditions are responsible for drastic changes in the yield variable of the cotton crop. For analysis and recommendation purposes the production years were divided into good (more than 60 qq/ha), fair (between 46-59 qq/ha), and poor (45 qq/ha or less).

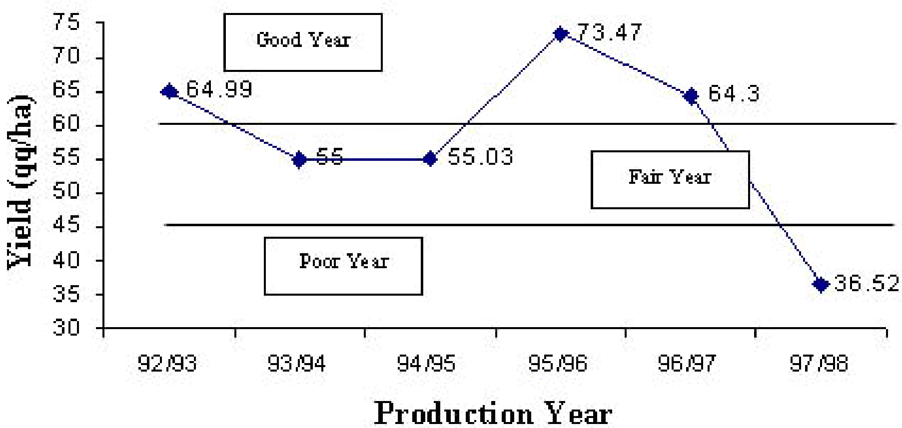

Figure 1. Annual Environmental Index for Cotton Yield in Cañete.

Linear programming was used to determine the capability of the targets to adopt the recommended alternative crops of grapes and asparagus. Data from numerous sources including a *sondeo*, survey, and selected secondary data were used in the development of the linear programming (LP) model. First, six multidisciplinary professionals conducted a *sondeo* (May 11 to 15, 1998) consisting of a sample of 22 farmers in the area. Members of the team had expertise in extension education, economics, and technical agriculture production. A *sondeo* is an open-ended, non-structured interview technique. The *sondeo* is an important needs assessment tool used frequently in the Farming Systems Research and Extension approach to agricultural development (Hildebrand, 1976). A properly conducted informal survey can provide accurate and comprehensive information on the ecology of farming and related practices (Rhoades & Bidegaray, 1987). According to Freanzel (1984), the *sondeo* has the following four distinguishing characteristics:

1. Farmer interviews are conducted by researchers themselves,
2. interviews are essentially unstructured and semi-directed, with emphasis on dialogue and probing for information (written questionnaires are never used),
3. informal random and purposive sampling procedures are used, and
4. the data collection process is dynamic. (p.1)

Each interview lasted between one and two hours. At least one adult household member was interviewed. In addition to the interviews, the researcher made and recorded personal observations regarding each household.

Second, one of the researchers conducted a survey (May 18 to July 17, 1998) consisting of structured questions developed based upon personal knowledge of the Cañete Valley, and the *sondeo* results. A questionnaire consisting of 70 items was developed. The instrument contained three sections. The first section had three subsections: (1) household information, (2) agricultural factors, and (3) economic information. The second section consisted of seven open-ended needs assessment questions. The final section included 13 open-ended questions regarding farm problems and concerns.

The population for the survey consisted of limited resource farmers in the Cañete Valley (N=4,800). A random sample of 60 farmers was selected for participation in the survey. In an effort to collect information that was reflective of the population, the researchers used a map of the Cañete Valley and divided the area into 60 zones. One zone was then randomly selected at a time by a computer program. The researcher subsequently randomly selected a limited resource household to interview in each zone. All households had an equal chance of being selected. Data were collected from a broad cross section of Cañete Valley residents. This technique allowed for equal geographic representation of subjects.

For both the *sondeo* and survey, households had to meet the following criteria: (1) farm less than 12 ha of land, (2) have a net annual income less than US$5,000, and (3) generate the majority of the household's income from agricultural production.

Secondary data were also used to complete the LP model from records maintained by the VGRI, from records maintained by the city government, and from records of Peru's Ministry of Agriculture. The data were analyzed using Microsoft® Access 97 SR-1, Microsoft® Excel 97 SR-1, and Microsoft® Visual Basic.

Based upon the data gathered, the assumptions identified in Table 1 of the livelihood systems of limited resource farmers in the Cañete Valley were made by the researchers. The linear programming model was designed to maximize discretionary cash at the end of the six-year model, after first satisfying all basic family needs.

Table 1
Assumptions of the Linear Programming Model

	Assumptions
1	There are two production seasons in Cañete. The matrix was divided into these two seasons: (1) August 15-April 14, and (2) April 15 – August 14.
2	Land is a limited resource in Cañete. Land use is intensive.
3	Renting land out to others and renting land from others were common practices of the limited resource Farmers in Cañete.
4	Labor is a limited resource, and labor availability is related to household composition.
5	Households can employ people in labor-intensive seasons, and it is common in households with available labor to work for others to supplement household income.
6	Water is not a limited resource in the August through April production season, but it is in the subsequent season.
7	Management is an aggregate index computed by summing the total years of education of every member in each household.
8	Credit is an available resource for cotton and maize in the August through April production season and for maize in the subsequent season. Interest rates range from 8-10% from development agencies and the banking industry. Credit is available for grape and asparagus production. However, cash credits for inputs from retailers are available at a rate of interest up to 100%.
9	Each household has some cash at the beginning of each season, used for household expenses, livestock, or production inputs.
10	The household and livestock consume maize and sweet potatoes produced on the farm. The family requires a certain amount of livestock produced on the farm.
11	Cash is transferred from one production season to another, and consequently one year to another.
12	The cash at the end of the year could be a negative value, indicating a non-sustainable system.

Results

The analysis of the cotton production functions demonstrated enormous variability among geographic zones in relation to yield and its response to fertilizers and environmental factors (Table 2). For example, the addition of N significantly contributed to production in only three of the seven agro-ecological zones. It should be noted that the regression coefficient for N was negative in two of these three zones. However in all zones the approved cotton production practice recommended by VGRI was to add from 110 – 250 kg/ha of N. Similar results were found for the regression coefficient for P (significant in three of the zones, and positive in only one of the zones).

A six-year linear programming model was developed to examine the viability of VGRI clients in adopting either a grape or an asparagus enterprise. Asparagus and grapes are two introduced crops being encouraged by development agencies. They are perceived as complex, but profitable. In an effort to encourage the adoption of these perennial crops, the development agencies are providing the financing necessary to establish the crops.

Table 2
Summary of Cotton Production Function Coefficients Based Upon Geographic Region

Geographic Zone	Intercept	R^2	N[a]	P[b]	K[c]	EI[d]	EIxN[e]	EIxP[f]	EIxK[g]
Cerro Alegre	88.79	.51	CN[h]	-4.01	-0.34	-6.16	CN[h]	0.071	CN[h]
La Quebrada	77.69	.51	CN[h]	-0.19	CN[h]	CN[h]	CN[h]	0.014	CN[h]
Palo Isla	-81.50	.84	-1.72	CN[h]	3.58	CN[h]	0.012	CN[h]	CN[h]
Santa Barbara	119.45	.30	CN[h]	CN[h]	-1.66	CN[h]	CN[h]	-.006	0.020
San Benito	44.57	.36	-0.87	CN[h]	1.58	CN[h]	0.016	-.025	CN[h]
San Francisco	-63.01	.77	0.46	4.90	-5.57	CN[h]	CN[h]	-.088	0.103
Quilmana	52.06	.54	CN[h]	CN[h]	-.84	CN[h]	CN[h]	CN[h]	0.010

N[a] Nitrogen in kg/ha; P[b] Phosphorus in kg/ha; K[c] Potassium in kg/ha; EI[d] Environmental Index; EIxN[e] the Environmental Index and Nitrogen in kg/ha Interaction Variable; EIxP[f] the Environmental Index and Phosphorus in kg/ha Interaction Variable; EIxK[g] the Environmental Index and Potassium in kg/ha Interaction Variable; CN[h] Regression Coefficient Not Statistically Significant at alpha of .05

The model maximized the sum of the end of the year cash for all six years after meeting all household (family) consumption needs. VGRI collaborates with other development agencies in financing the establishment of both crops. In the case of asparagus, there is a requirement that a small farmer plant at least one hectare due to harvesting and marketing concerns. Table 3 reveals the resource needs of asparagus in the six year model.

Similarly, the grape resource needs are presented in Table 4. These analyses revealed that no household was financially capable of adopting a grape production enterprise. However, 25 of the 60 would be able to adopt one-hectare of asparagus.

In an attempt to explain the adoption curve for the production of asparagus, the researchers examined overall household system dynamics. Without losing system diversity, there were some naturally occurring household groupings (Table 5). Those 25 households were characterized as having fewer children living at home and consequently, more available adult labor. These households were also characterized as having larger farms and more fertile farms (located in the lower to middle valley range). Finally, these households were the more highly educated.

Table 3
Asparagus Resource Needs in the Six-Year Linear Programming Model (per hectare)

Resource	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Male Labor[a] I[b] (days)	15	15	45	30	30	30
Male Labor II[c] (days)	15	15	45	30	30	30
Female Labor I (days)	2	4	15	12	12	12
Female Labor II (days)	2	4	15	12	12	12
Water I (m^3)	3,000	3,000	3,000	3,000	3,000	3,000
Water II (m^3)	1,500	1,500	1,500	1,500	1,500	1,500
Management I (Unit)	5	5	5	5	5	5
Management II (Unit)	5	5	5	5	5	5
Credit I (Soles[d])	2,500	2,500	2,500	2,000	500	2,500
Credit II (Soles)	1,500	1,500	1,500	1,500	500	2,000
Household Cash I (Soles)	-----	500	500	500	500	500
Household Cash II (Soles)	-----	500	500	500	500	500

Labor[a] Denotes labor (either male or female) that is determined by the number, age, and gender of the household members. Each child younger than 5 years requires 0.75 day-labor per day, each child between 5 to 14 years contributes 0.5 day labor per day as well as the males older than 65 years and the females older than 75 years. The males between 14 to 65 and the females between 14 to 75 years contribute 1.00 day-labor per day to the household. The female labor is more limited than the male because they attend children, maintain the home, and care for most of the livestock; I[b] Denotes labor required for the first production season (August 15-April 14); II[c] Denotes labor required for the first production season (April 15 - August 14); Soles[d] - 3.5005 Peruvian Soles = 1.00 US Dollar

Table 4
Grape resource needs in the Six-Year Linear Programming Model (per hectare)

Resource	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Male Labor[a] I[b] (days)	20	15	30	30	30	30
Male Labor II[c] (days)	20	15	30	30	30	30
Female Labor I (days)	5	5	30	30	40	40
Female Labor II (days)	5	5	30	30	40	40
Water I (m^3)	2,500	2,500	2,500	2,500	2,500	2,500
Water II (m^3)	1,500	1,000	1,000	1,500	2,500	1,000
Management I (Unit)	5	5	5	5	5	5
Management II (Unit)	5	5	5	5	5	5
Credit I (Soles[d])	3,000	3,000	3,000	2,500	1,000	2,500
Credit II (Soles)	1,500	2,000	2,000	2,000	500	2,500
Household Cash I (Soles)	-----	1,000	1,000	1,000	500	500
Household Cash II (Soles)	-----	500	500	500	1,000	1,000

Labor[a] Denotes labor (either male or female) that is determined by the number, age, and gender of the household members. Each child younger than 5 years requires 0.75 day-labor per day, each child between 5 to 14 years contributes 0.5 day labor per day as well as the males older than 65 years and the females older than 75 years. The males between 14 to 65 and the females between 14 to 75 years contribute 1.00 day-labor per day to the household. The female labor is more limited than the male because they attend children, maintain the home, and care for most of the livestock; I[b] Denotes labor required for the first production season (August 15-April 14); II[c] Denotes labor required for the first production season (April 15 - August 14); Soles[d] - 3.5005 Peruvian Soles = 1.00 US Dollar

Table 5
The Relationship Between the Adoption of Asparagus Production and Household Composition

Ha of Asparagus	Composition One[1]	Composition Two[2]	Composition Three[3]	Composition Four[4]	Land (ha)	Management/ Education
No Asparagus (13.33%)	0.50	0.79	1.71	1.64	4.35	20.69
Less than 1ha (35%)	0.19	0.67	2.24	2.14	4.11	31.90
1 ha or greater (41.67%)	0.08	0.56	2.56	2.60	5.45	38.19
Solution for "Average" Household .84 ha of Crop	0.21	0.65	2.25	2.22	0.18	31.48

[1] Number of males and females less than five years of age
[2] Number of males and females between five and fourteen years of age
[3] Number of males between fourteen and sixty-five years of age
[4] Number of females between fourteen and sixty-five years of age

Conclusions and Recommendations

In terms of cotton production, the results of this study revealed the need for VGRI extensionists to make fertilization recommendations on an individual household basis, being particularly cognizant of agro-ecological zones. The production functions demonstrated that, contrary to common belief, higher yields are not necessarily reached with higher amounts of fertilizers. Actual recommended fertilizer rates are too high, probably being based upon trails conducted on the very best soils in good years. This finding also has significant implications for environmental pollution associated with overfertilization practices and subsequent leaching from the soil into the water system.

It should be noted that the fertilization rates used by the farmers in these analyses were the amounts recommended by VGRI (i.e. 110-250 kg nitrogen/ha). As a result, there was little experimental variation within zones. Therefore, it is recommended that on-farm trials with greater variability in nitrogen and phosphorous rates be conducted.

The production functions can also be used as decision-making tools based upon rather predictable weather patterns in the area. During the El Nino and La Nina years, a poor year (due to extreme weather conditions) might become a good year for some geographic regions of Cañete (i.e. Cerro Alegre and San Francisco) if recommended fertilizations were adequately adjusted. Not only might production be increased, but also due to the deleterious effect of the weather on production in other growing regions, the farmers could get the added benefit of higher cotton prices.

As per the linear programming results, small farmers should not be a targeted audience for grape production. In addition, only approximately 40% of the target clientele would be able to add an asparagus enterprise. Perhaps the biggest advantage to developing the linear programming model is that it is now readily available to use as a consulting tool at the individual household level. It can be used by extensionists to predict differing household livelihood system responses based upon various scenarios.

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A Formative Evaluation of Valle Grande Rural Institute in Cañete, Peru

A Critique

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Formative evaluations are valuable in determining program performance feedback relative to program process and/or program outcomes. Information received from such evaluations can help make modifications to programs in order to better utilize program resources.

This study sought to appraise the quality of recommended cotton fertilization practices of Valle Grande Rural Institute, a nongovernmental organization, in Canete, Peru. Furthermore, the paper sought to examine Canete's low resource farmers' ability to incorporate two alternative cash crops into their livelihood system. The purpose and objectives of the study were clearly stated. The authors did an excellent job of providing background information for the study. The authors did an adequate job in defining the theoretical framework, however, I would encourage the authors to expand some more on the theoretical framework.

Appropriate and interesting research procedures were used to collect data in the study. However, I have some questions regarding the sample sizes used in the study. When collecting data to use in the production function, why was such a large sample size (n=622) used? In most cases, is not a sample size of 300 appropriate for generalizability? Furthermore, why was such a small sample (n=60) used to collect data for the linear programming function? I am curious to know why there was such a discrepancy in the sample sizes used in the study.

I had some difficulty in understanding the results from the study, primarily in understanding the information reported in the tables. I would encourage the authors in further publications to thoroughly explain the information in the tables so the readers can clearly understand the results of the study.

I found the conclusions to be straightforward. However, I wish the authors would consider developing more programmatic recommendation for practice and research. What could be some specific practices recommended to the farmers and what could be additional areas that could be evaluated in this study?

In closing, I commend the authors for conducting an important study. Such evaluations are necessary in extension activities in programmatic changes are to occur. Since this paper of only part of a larger study, I would be interested to read the other results and conclusions of the study. I encourage the authors to see to report this information and encourage their assistance in helping to improve farming practices in Peru.