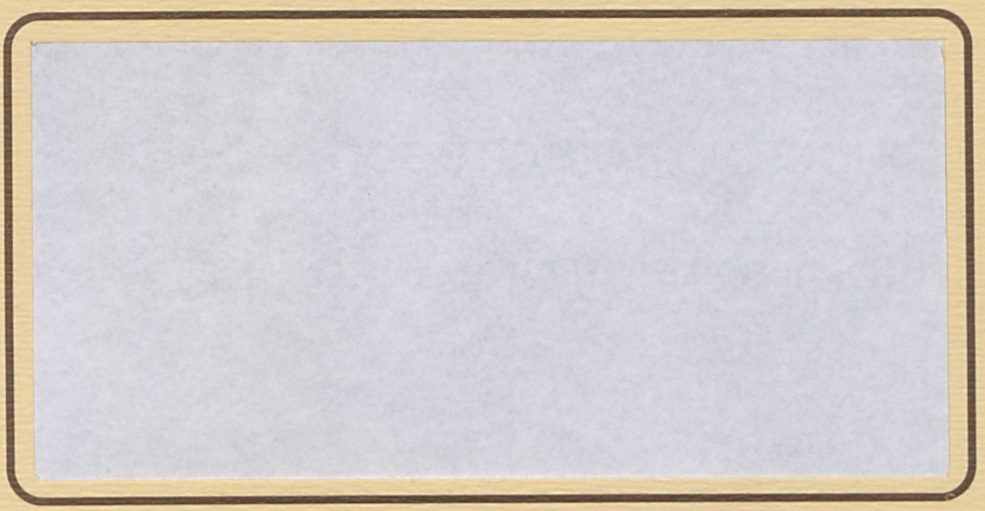
RURAL ECONOMY



PROJECT REPORT

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COMMERCIALIZATION AND PRICE RESPONSE WITHIN A BEAN GROWING FARMING SYSTEM OF COLOMBIA

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I. Introduction

Farmers' behaviour may be characterized as a dialogue with their economic and natural environments. The economic environment is subject to modification with policies presumed to condition or evoke a desired behaviour on the part of farmers, such as adoption of a new variety of beans. A precondition of effective policy is having a good idea of the likely outcomes of the policy measures. The behaviour of farm units may be extremely heterogeneous rendering the average or representative farm inadequate as a basis for policy prescription (Boussard, 1985, p. 34). Presumptions that an average response is representative of the population may turn the expected response into high cost wishful thinking. In no situation is this analytic inadequacy so true as that of commercial farming systems emerging from subsistence under conditions of agricultural development.

Heterogeneity of response is problematic for both price and technology policies, such as price support measures, the introduction of varietal technologies, new inputs, or irrigation schemes. Technology deemed appropriate to a particular farming system into which it is being introduced is not usually accepted willingly by all farmers within that system. Technology is only appropriate to the extent that farmers are willing and able to accept it. Conventional thinking on this problem leads to questions about profitability and sociological behaviour. Price policies and economic incentives may be contrived to ensure profitability. Early adoptors and opinion leaders may be signaled out by extension agents to begin the process of acceptance. Yet it is not usually understood what distinguishes farmers who adopt a technology from farmers who are informed about it but remain very resistant to change. Mellor was one of the early writers on the subject advocating important research to study variability within communities, to provide guidelines for action programs (Mellor, 1969, p. 216). In the 20 years since then, technology and price policies do not reveal that policy makers have found much useful in the outcome of such research.

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[1] Presented at the CAEFMS annual meetings, McGill University, Montreal, July 1989.

The research described in this paper attempts to shed some light on this old problem through use of a new field technique. The subjects' individual price responses were measured using an original-constraint tradeoff game, called the 'Frisch Interview' technique. The project was originally intended to examine the response of bean farmers to changes in commodity prices, in conjunction with a varietal improvement program at the *Centro Internacional de Agricultura Tropical* (CIAT).

Unimodal price-response behaviour was assumed at the start of the research. Unexpectedly, however, the cross-sectional interviews revealed a marked trimodal behaviour pattern, delineated by the respondent's perception of the substitutability of crops. This paper reports the characteristics of these three population groups. It will subsequently be proposed that this behavioural phenomenon within the process of commercialization is closely linked with the way an agrarian system opens its boundaries to its economic environments.

The field work for this study was carried out within the mixed Spanish and Indian population of the district of Ipiales, located in the province of Nariño in the southwest corner of Colombia. The region is mountainous, with altitudes exceeding 2600 meters above sea level. The steep slopes and cool, cloudy climate restrict agricultural production. The area of arable land is limited. However the region's volcanic soils are inherently productive.

The main crops grown in the district are maize and beans, which are intercropped, and potatoes, barley, wheat, peas, broad beans, quinoa and vegetables. Maize and potatoes are staples, though potatoes may also be a commercial crop. Beans, barley and wheat are grown for cash. Peas and broad beans are both food and cash commodities, though they are grown primarily for the market. Livestock production is an important part of the farming system.

II. Sampling and Survey Method

Micro-economic data were collected from 61 randomly-selected farms in six villages which have been the target of the CIAT programs to introduce new bean varieties. The villages, or veredas, are the smallest political units within the district, and were selected to provide a homogeneous natural and economic environment for the sampling frame. Characteristics of the *veredas* were compared to ensure homogeneity using analysis of variance.

The veredas exist in the same natural, economic, institutional and political environment. All have similar transportation facilities and are located within 10 to 20 kilometres of the city of Ipiales, their main market for agricultural goods. Consequently, given the homogeneity of the overall environment, the farmers' price-related behaviour may be attributed to the individual charactersitics of their farms.

The behaviour of each respondent was assessed through two questionnaires and two interviews, both techniques having been pre-tested on other area farmers. During the first interview, biographical and production data were collected; during the second, some weeks later, a modified form of the Frisch interview technique was used.

The latter was developed by Ragnar Frisch, based on work during the depression (Frisch, 1932), to estimate marginal rates of substitution among certain political groups for policy targets such as inflation, unemployment, and interest rates. The technique was based on the generalized theory of preferences and choice. Frisch's aim was to estimate objective welfare functions, joining the wider effort by Tinbergen and others to quantify economic policy. The technique was adapted in this research to Andean bean farmers to overcome the absence of price-quantity data for estimating supply response (Anderson Medellin, 1988). Several Frisch tradeoff 'games' were played by each respondent, usually in consultation with their spouse. The interviewer was fluent in Spanish, and a relaxed, trusting atmosphere was judged to prevail in each case.

The farmer and spouse were offered the choice between two different combinations of bean and potato seeded areas proxied by masses of seed. One combination involved a small area of beans and a relatively large area of potatoes. The other combination offered the reverse porportions. In both cases the areas added up to those prevailing on the farm. The game was played twice. The price of beans was set at each end of the relevent range based on recent history, while the price of potatoes was held constant. The iterative procedure converged to a point where the farmer and spouse were indifferent between the two options. This point was theoretically a tangency between the production possibility curve and the price line where the marginal rate of substitution of beans for potatoes was equal to the ratio of the price of potatoes to the price of beans.

III. The Farming System

The farming system at Nariño is at an intermediate stage of development between subsistence and commercialization, with farmers beginning to use industrial inputs and to sell a portion of their production. This commercialization means the system is opening its boundaries to the economic environment. As is characteristic of subsistence agriculture, the activities within the system are closely interrelated and interdependent. Crops and livestock are related by stubble, stover, organic manure, draught power and transportation in a risk reducing complex of activities.

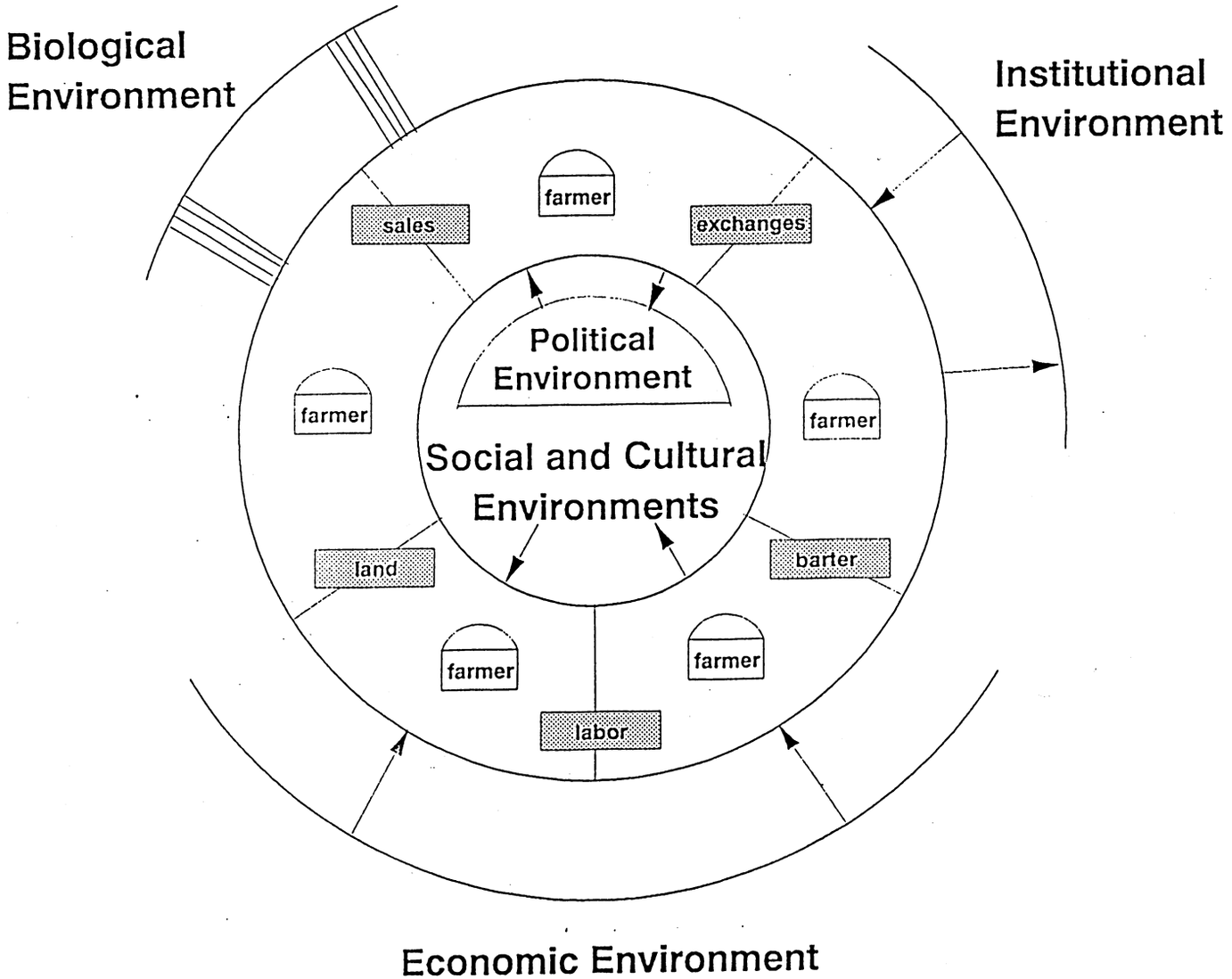
Figure 1 presents a schematic representation of the Nariño farming system. The ring represents the agricultural system formed by the farming systems. At the center of each farming system are the farmers who decide on the distribution of the farm proceeds according to the household's needs and wants. The farms and farming systems are related through the flow of resources, on a cash or barter basis, the flow of information, and the sharing of land or animals.

The environment surrounds the system from every direction represented in Figure 1 by placing the political, cultural and social environments at the centre. Different levels of commercialization or subsistence are defined by the openness or closeness of the agricultural system to the economic and natural environments. Both environments influence the system. The farmers have little power to change the economic environment and no power to change the natural environment (ecosphere). More subsistence or traditional farmers minimize the unpredictable effects of the biological and physical aspects of their natural environments through diversification of farm activities. More commercial farmers try to close their system to the natural environment through the use of industrial inputs.

The political environment influences the farming system with policies. Farmers in Nariño can somewhat affect the political environment through pressure groups, such as the *Juntas de Acción Comunal*. The institutional environment affects the farming system but may be responsive to feedback from the farmers, as should be the case in the development of new technologies by research institutions.

The technology involved in this work was new bean varieties and associated agronomic practices. Price responsiveness was examined relative to potatoes and beans. Beans and potatoes are never intercropped, so they are not complementary with respect to the land base but they may be with

Figure 1: Schematic Representation of the Farming System of Southern Nariño, Colombia



respect to other inputs and obligations. The dual characteristic of beans/maize and potatoes as complementary or substitute crops is understandable knowing that the maize/bean crop combination and potatoes have both subsistence and commercial characteristics. Beans are sold while maize is consumed. Potatoes are half of the time sold and half of the time consumed on the farm. If one crop is seen by the farmer as the cash crop and the other one as a food crop, they could be complements because the farmer may need money from sales of the commercial crop to buy inputs for production of the food crop. If both crops were seen as mainly food crops. then a complementary relationship could be suspected because farmers like to consume both maize and potatoes, and must plant certain proportions of each crop to remain satisfied.

IV. Classification of Farmers

The 52 farmers were classified in three groups distinguished by perceptions of crop relationships. Members of the first group, called the *Substitute response group,* viewed beans and potatoes as cropping substitutes. Members of the second group viewed the two commodities as complements, and thus were called the *Complementary response group.* The third, *No response group* comprised the 26 farmers who could not respond in a conventional way to the price-related questions.

The responses of each participant were subjected to an analysis of variance using the SAS General Linear Model (GLM) software. Twenty-six variables were examined for each respondent. These included biographical data such as age, education and family size; and production data such as technological knowledge, farm size, form of land tenancy, and area planted to beans, maize, barley and potatoes. Income and commercial orientation were also examined, to determine the strength of the farmer's relationship with his economic environment.

The results of the statistical analysis described above are shown in Table 1. The Substitute response and No response groups appear to form opposite ends of a continuum of values for most of the 26 variables. The mean values of the Complementary response group lie mainly within this continuum.

Table 1: Average Value of Selected Descriptive Variables for a Sample of Farms, Nariño District, Colombia, 1986

Variables	Means		
	Substitute	Complementary	No response
Farm Biographies			
Size of family*[a]	6.8	5.2	4.9
Size of farm(ha)[b]	2.6	3.3	1.9
Land per capita*[b]	0.4	0.8	0.4
Proportion of area owned(%)	43	60	63
Attitude Toward Technology			
Farmer's age (years)**[a]	37.1	45.8	49.7
Farmer's education (years)	3.5	3.1	2.5
Use of technology (grade A)	10.7	10.1	9.3
Knowledge of technology (grade B)**[c]	3.4	3.3	2.5
Use of credit (no. times in 10 years)	4.3	3.6	3.0
Crop Area (ha)			
Maize/Beans	0.9	1.7	1.0
Potatoes**[c]	0.6	0.4	0.2
Barley	0.3	0.3	0.2
Annual Crop Production (100 Kg)			
Maize	3.9	5.5	3.2
Beans**[c]	2.7	2.8	1.3
Potatoes	44.1	29.5	19.2
Annual Crop Sales (100 Kg)			
Maize	0.4	1.1	0.0
Beans*[c]	2.3	2.3	1.1
Potatoes	23.1	15.9	6.7
Annual Consumption (100 Kg)			
Maize	4.6	4.9	3.6
Beans*[c]	0.4	0.5	0.2
Potatoes	16.8	15.4	19.9
Income from Sales and Animal Stock (Colombian 1000 pesos)			
Value of animals owned	88.0	112.0	116.3
Income from beans***[c]	44.4	44.0	18.6
Income from potatoes	53.2	35.6	13.7
Income from beans, maize and potatoes**[c]	98.5	83.6	32.8
Per capita income from sales **[c]	15.1	15.9	6.3

Source: Survey results. Figures rounded to nearest decimal.
Significance level indicated by *(10%), **(5%) and ***(2.5%).
[a]Indicates difference of Substitute versus the average of Complementary and No response.
[b]Indicates difference of Complementary group versus the average of the Substitute and No response groups.
[c]Indicates difference of the Response groups together versus the No response group.

A. Substitute Response Group

This group contains the youngest farmers, with an average age of 37 years, and the largest families. Members are better educated than their counterparts in the other two groups, use more inputs in maize and bean cultivation, and know more about these inputs. Although they use credit more often, they own a smaller proportion of the land they cultivate relative to members of the Complementary and No response groups.

Substitute response farmers on average grow more barley and more potatoes than other survey participants. They also sell more potatoes, and consequently have higher incomes averaging 98,500 pesos from crop sales. However, they own less livestock than members of the other groups.

B. No Response Group

The No response group contains the oldest farmers and consequently the smallest families. Members' farms are also smaller, averaging 1.9 hectares, which may reflect the release of rented fields or the transfer of land to children. As might be expected, No response farmers, being older, own a larger percentage of the land they cultivate.

The No response group seems to represent a very closed system, using fewer industrial inputs, having fewer connections with the outer environment including technicians or the market system. Variables other than price, such as status, tradition, and ecospheric risk appear to weigh heavily in their decisions. These farmers are the most experienced and least educated. They have the least knowledge about the industrial inputs they do use, among the three groups of farmers.

Members of the No response group are clearly distinguished by their attitudes toward risk and their relationship with the economic environment. For example, members cultivate smaller total areas of potatoes -- an average of 0.2 hectares, versus 0.4 and 0.6 hectares for the Complementary and Substitute response groups respectively. Consequently they sell only 670 kilograms of potatoes per year, while their Complementary and Substitute response counterparts sell, respectively, 1590 and 2310 kilograms.

This evidence suggests a greater aversion to economic risk among the No response farmers. They apparently produce potatoes primarily for their own consumption, choosing to

minimize their involvement in the volatile potato market. As a consequence, group members have the lowest annual income from sales of maize, beans and potatoes. Moreover, even though maize production in the No response group is similar to that in the Substitute group, not a single No response farmer sold maize in 1984. It is notable, also, that the No response farmers own more livestock than do any of the other respondents. Animals in this culture as in many others are retained as a means of attenuating risk and financing major family events.

Finally, members of the No response group use credit less frequently than farmers in the other two groups, demonstrating an unwillingness to become involved with their institutional environment.

C. Complementary Response Group

Complementary response farmers comprised 25 percent of the interviewees. Given the variance for most variables, this number was too small to provide statistically significant evidence (at the five percent level of confidence) of their existence as a distinct group. However, the pattern of their responses does appear to distinguish them from the other two groups.

The Complementary response farmers seem to occupy an intermediate point in a continuum of values for characteristics between values for the Substitute and No response groups. They occupy the middle ground in terms of age, family size, use and knowledge of technology, use of credit, production of potatoes and barley, and proportion of farmed land owned. Their incomes from the sale of beans, maize and potatoes are also of intermediate value, though closer to the Substitute end of the continuum; likewise the value of their livestock, although in this they are nearer the No response extreme.

The Substitute/Complementary/No response continuum of values for farm characteristics is not an entirely consistent pattern. Complementary response farmers own the largest farms (with an average area of 3.3 hectares), grow the greatest quantities of maize and beans, sell the most maize, and have the smallest families. Their small families and large holdings also give members the highest land/person ratio of the three groups, as well as the highest overall income per family member (Table 1).

V. Discussion of Results

The major factor differentiating these groups is the level of commercialization of the farmers. The response to economic signals is relatively homogeneous within each group. Medani provides supporting evidence to these arguments. In a study done in Sudan, Medani divided a sample of farms into 6 groups, denoting different levels of development defined "according to the extent to which they are involved with the market mechanism in purchasing their inputs and selling their output." Medani's study concentrated on the four more subsistence groups. He calculated their respective price elasticity of marketed surplus for sorghum. These elasticities proved to differ among groups on the basis of an F test. Even though he did not find a general pattern in the estimates, it was evident that the least-developed group had the lowest estimate, while the most developed group had the highest surplus response elasticity.

This research did not anticipate that the evidence would do other than provide a measure of the substitution behaviour by the farmers in response to changing relative prices. That three quarters of the responses signalled some other perception by the farmers about the bean/potato relationship suggests reexamination of the assumption of crop competition on these farms.

Beans and potatoes do compete in their requirement for field space, at certain times for labour and may also compete for financial resources. The production possibility curve should be concave in the northeast quadrant. These results suggest, however, that other issues may outweigh factor constraints in the minds of farmers and that these other issues may be given different weight according to the degree of commercial development of the farming system.

The No response farmers may be portrayed as decision-makers who either don't see beans and potatoes as competitors for resources, or who attach little weight to relative bean and potato prices in decisions. The Complementary response farmers in contrast appear to recognize relative prices in their decisions, because they perceive beans and potatoes as complements. A higher price for one crop enables lower production of that crop and expansion of the other. Either these farmers are exhibiting satisficing behaviour or non monetary goals are important in optimizing crop combinations.

Satisficing is consistent with reducing bean acreage as the price of beans increases. Incidental information volunteered during the field work indicates that potatoes play a role in family obligations

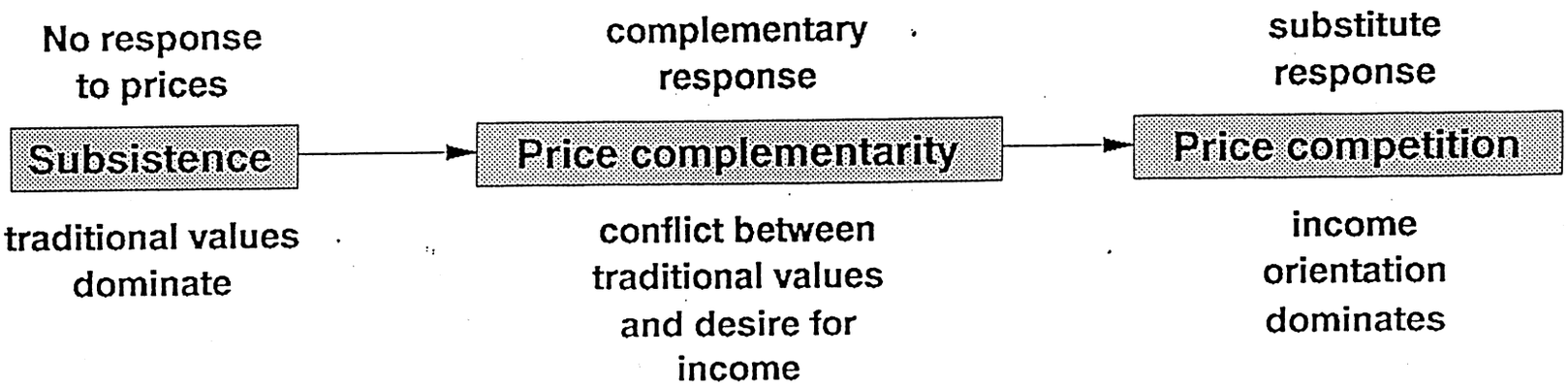
not fulfilled by beans. The reported traditions relating to merit in being able to supply extended families with potatoes are easier to satisfy when higher bean prices enable land to be planted to potatoes. These values could be expected to prevail in families of older farmers and are consistent with technological awareness. However these kinds of values compete with the economic objectives of profit and cash income.

The presence of two opposite behaviours within the price-responsive group suggests the existence of a commercialization continuum, in which the three groups of farmers (No response, Complementary and Substitute response) represent three sequential points in an overall process of commercialization (Figure 2). The intermediate stage, embodied by the Complementary response farmers, is characterized by a conflict between traditional values and the desire to increase cash income.

This conflict may be understood as a phenomenon along the boundary of the agricultural system in which its cultural environment predominates over the economic environment. The relative weakness of economic forces (prices) for the No response group could be explained by a relatively more open boundary with cultural forces. The argument could be extended in the systems context by considering the cultural environment as a distinct subsystem, together with agriculture, within a more broadly conceived agrarian system. The notion of a continuum in a commercialization process becomes a question of how the boundary of this agrarian system is progressively opened to the economic environment of monetary prices. This argument does not deny the existence of tradeoff mechanisms within the agrarian system, but rather singles out the role of monetary prices and their relationship to supply response behaviour.

A positive supply response to price may be considered the outcome of a process of changing the focus of exchange to the economic environment from within the agrarian system through a market discovery process. Price and quantity discovery with attendant assembly activities develop at the boundary of the system. The handlers, processors, distributors and consumers may be considered conceptually and spatially to operate from within other systems within the economic environment of the agrarian system. The willingness of farmers to create larger agricultural surpluses is thus related to the openness of the boundary with this environment in terms of ease of transaction, immediacy of

Figure 2: The Commercialization Continuum Within the Development Process of the Bean Farming System



revenue and confidence. However, even more important may be the balance for the farm family between their perceptions of the continuing existence of conditions which lead to the cultural subsystem in its present form and the desire for material gain.

VI. Policy Implications

The policy implications for technological transfer and price policy under these conditions of heterogeneity in population behaviour do not conform to conventional thinking. Agronomic and genetic work to improve crop production in a farming system presumes a need for more output at any and all the various points along a commercialization continuum. However better varieties appear to have limited appeal for the economically unresponsive farmers, a perverse impact for emerging commercial farmers and may encourage more output only for farmers open and responsive to their economic environment. The new CIAT varieties of beans were not being adopted readily in the region and were not being reported as grown by the respondents. This lack of observed response to the CIAT varieties fits well with the results of this research in that only 25 percent of the population could be expected even to consider trying the new varieties. It seems as if new varieties and agronomic method are only two parts of the process of behavioural change that constitutes agricultural development. It is not so much a question in farming systems development of whether new varieties are better than old varieties as to whether the new varieties fit or even enhance the process of commercialization of the farming system.

New varieties are better if growers perceive an advantage of performance within the natural environment. New varieties are also better if they reduce system entropy with the ecospheric environment. In this sense, pest and disease resistence, drought tolerence, strength of stem and so on are crop characteristics which help the farmer close the boundaries of the farming system to adverse events in the natural environment. However the coincident agronomic technology usually involves recurrent industrial inputs and so requires an opening of the boundary with the economic environment, or commerical activity. Similarly if output is enhanced, market opportunity sooner or later becomes necessary and the commercialization process moves forward.

Price policies are part of the economic environment to the farming system. When a new crop variety is introduced into a subsistence system, government has at least three pricing options. One is to let markets determine the price; two, support the price of the commodity in question; and three, subsidize input prices. At early stages of commercialization prices should not make a difference in the appeal of the variety to farmers, according to the evidence of this work. Thus the price policy issue relates to the ongoing process of commercialization of the system.

Market prices determined competitively or under monopsonistic market structures tend downwards in real terms as agrarian systems become more commercial. Herdt's review of the effects of the green revolution in rice production in the Manila and Laguna regions of the Philippines is a classic illustration (Herdt, 1987). Thus market determined prices should encourage commercialization at immediate stages but may dampen response to new technology at later stages relative to what the response could be with higher prices.

An alternative to 'free' markets is government intervention to stabilize or support prices. This intervention could be considered as part of a technology package. The results of this research suggest ineffectiveness for such intervention if the farming system is at early to intermediate stages of the commercialization process. Early could be defined, in terms of these results, as under half the farmers being price responsive, with half or more of these responsive farmers viewing the crop in question as a complement with other crops. These farmers would reduce output with higher prices. For systems at later stages of commercialization, incentive market interventions would encourage adoption of new varieties and output, but could be too expensive for less developed economies or worse, regressive for consumers (Weber *et al* 1988). Producer price incentives thus seem to be problematic.

The third market policy alternative is intervention in input markets to lower input prices. Additional industrial inputs are often coincident with new varieties. This research did not address inputs price response. However, the farmers of Ipiales, especially the No response group display an aversion to risk in the complexity of their farming systems and livestock holdings. The primary function of inputs subsidies is to offset perceptions of higher ecospheric risk and to reduce the financial risk of the adoption of technology inherent in the inputs. Subsistence behaviour in general is the consequence of system adjustments to uncontrolled events in environments. Subsistence, risk

avoidance and systems closure are intersecting concepts. The results of this research interpreted from this viewpoint suggest that concessional inputs pricing may reinforce the substitution of one crop for another for those farmers who perceive a substitution relationship. No response farmers could not be expected to respond to inputs pricing. Their late life cycle characteristics suggest that the commercialization process has more to do with their successors. The results do not shed any light on the role of concessional inputs pricing on the engagement by farmers in the transition to a substituting behaviour from a complementing behaviour.

The results may be interpreted, finally, as casting doubt on some conventional means of classifying farmers for policy targetting. Farm size is not a useful basis for classifying farmers, contrary to Mellor's argument, but in agreement with Boussard. Neither is predominant form of tenancy a useful criterion, at least not with the predominant land-sharing agreements in the area.

VII. Conclusions

The results suggest the presence of at least three behavioural groups of farmers in the process of commercialization of a farming system. One group is unresponsive to output prices. These farmers may be described as purely subsistence, being older, cultivating less area, being diversified, holding an above average inventory of livestock, owning a higher proportion of their land and selling little. Their part of the farming system is closed to the economic environment and relatively open to the natural environment.

The second group is price responsive but views crops as complements in socio-cultural, rotational and financial contexts. The group has closed the boundaries of the farming system with its natural environments by the use of industrial inputs, and has partially opened the boundaries with their economic environment. Traditional values and perceptions indigenous to the larger agrarian system appear to hold profit motives in check resulting in a satisficing type of behaviour.

The third group of bean growers is also price responsive but view crops as substitutable in the face of price changes. This group demonstrates commonly understood commercial behaviour leading to increased output in response to higher price and new technology. This group has made considerable progress in closing the boundaries of their farming system with the natural environments while

opening the boundaries with the economic environment.

Viewing the process of commercialization of agriculture as a continuum, the bean growing farming system of Nariño is at early stages of commercialization. Half the farmers are unresponsive to prices, a quarter would decrease area seeded to beans with higher bean prices relative to potatoes, and a quarter would respond positively to higher prices for beans. Only this last group could be expected to attempt to increase output of beans when offered market incentives to go with the new varieties and agronomic improvements made available to them. The results of the work do not permit any conclusions about the role of pricing or of new varieties in speeding up the process of commercialization. The results do indicate that agrarian systems and maybe farmers themselves in this process may pass through a phase of behaviour in which higher prices can be a disincentive to output.

The policy implications centre around pricing and targetting. Farm area size was not found to be associated with price response and therefore not a useful criterion for targetting. Per capita income from sales enabled distinction between price responsive and non responsive farmers. However this measure of performance did not distinguish between the two types of response. Volume of sales from maize, beans and potatoes combined was a distinguishing factor but is difficult to measure.

Price incentives coincident with the introduction of new varieties into traditional subsistence agrarian systems would not likely be effective in promoting adoption of new bean varieties. Research is needed to understand how the process of commercialization, with consequent price response, occurs for agrarian systems emerging from subsistence. Focus should be placed on ways to reduce the length of time a farming system remains in the complementary phase of the commercialization process. Then it will be possible to design economic policies which accelerate the process and complement agronomic and genetic progress. Field techniques such as the Frisch interview procedure to measure tradeoff behaviour in the absence of statistical records, appear to be useful for this type of research.

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