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Abstract

Agricultural information and indigenous knowledge were examined among peasants of the central Ethiopian highlands. Measures of central tendency, logical explanation, descriptive analysis, problem solving tests, scoring and logit analysis were performed.

The findings indicate that information from extension agents tends to favour peasant associations or farmers that are closer to cities, service cooperatives, politicians and extension agents. Despite variations in the sources and access to information, the extent to which information is subjected to conscious processing determines its value to decision-makers. Furthermore, the value of information is greatly influenced by indigenous knowledge or social experience and schooling.

Farmers who are beneficiaries of projects and friends with politicians received higher scores on production problems compared to the control group. Production knowledge is found to be locale-specific and varies by age. Production knowledge is greatly influenced by experience, index of awareness, proximity to infrastructural facilities and sources of information. The findings also indicate that education enables households to relate production problems to experience and outside information. Development strategies could facilitate the attainment of food self-sufficiency if the contents and delivery mechanisms of agricultural information are equitable, and indigenous production knowledge of peasants is integrated with secular and extension education.

Agricultural Information and Indigenous Knowledge in Peasant Economy

Introduction

Development strategies often focus on outcomes of household decisions (e.g., yield/ha or amount of milk/cow/day). However, household decisions are the result of interaction between non-physical resources (e.g., information, experience, knowledge and institutions) and physical resources (e.g., land and labour). Assessment of differential access to information and knowledge helps to identify factors that influence decisions to adopt new innovations, participation of farmers in intervention strategies and the design of environmentally sustainable development strategies or plans.

Analysis of information and knowledge of households is an important element in the study of household economies. Households have to identify sources, accessability and comprehendability of information. Societal value systems, institutions and prior experience provide meaning to information. Information processed and experience contribute to skill that is the driving force of actions of decision-makers.

Households make various kinds of decisions (e.g., consumption, marketing, labour allocation, etc.). Production decisions are critical to the reproduction of the household and the farming unit. The present study focuses on information and knowledge related to production and marketing of agricultural products. The findings of this study are expected to I) contribute to the design of strategies that will enhance dissemination and comprehension of information, ii) help initiate programs that will incorporate indigenous knowledge in the design and implementation of projects aimed at securing subsistence food requirements, and iii) reinforce the need to integrate indigenous knowledge with secular education so that the latter could become functional

(see Eisemon, 1988).

The problem

In examining information, three important points ought to be considered: types, sources and accessibility of information. The types of information gathered depend on the goal of the subjects. The sources of information could be formal (e.g., extension agents) or informal (e.g., friends). The sources of information vary depending on the degree to which subjects articulate themselves with the larger economy.

The ability of subjects to make use of information depends on the types of processing mechanisms. There are two types of information processing mechanisms, the conscious and the unconscious. Unconscious processing refers to any information processing that is outside of a decision maker's ordinary attention and awareness. This processing underlies routine decisions. Conscious processing involves long-range planning and critical thinking. The ability to suddenly shift attention suggests that humans are continually monitoring their environment for matters of immediate importance, unconsciously processing, to some degree, a variety of information. The larger the amount of information subjected to critical or conscious thinking, the more likely that it will form part of experiential knowledge.

Indigenous or local knowledge refers to skills and experience gained through oral tradition and practiced over many generations. It is this knowledge which serves to solve daily problems and open employment opportunities for peasants. Variations in knowledge can be observed by sex, age, ethnic group, and degree of contact with the outside world (Norem, et al., 1988). The potential of indigenous knowledge to form the basis on which development strategies

should be built is discussed in Warren, et al., (1989), Geertz (1983) and Richards (1985). This knowledge can, however, be general or specific to individuals.

Farming system specialists have strongly argued that producers or households are not always in "equilibrium" with the ecosystem (Gilbert, et al., 1980; Hendry, 1987; Shaner, et al.,1982; Thrupp, 1989). The moment an element of the system is injected through intervention, the balance changes, leading to another locus of equilibrium or disequilibrium. Schultz (1975) argued the need to invest in people as a strategy to facilitate adjustment to changes or disequilibrium.

Often the content of agricultural information in less developing countries is devoid of inputs from peasants. It is based on the need to modernize agriculture without due consideration to the goals and strategies of households, the types and sources of information, the manner in which information is received and processed by farmers. Consequently, agricultural development strategies will not have the support of potential beneficiaries (peasants).

Several researchers have argued that peasants possess a wealth of information and knowledge that may excel the value of "modern" agricultural skill in solving crop and livestock production problems. Secular agricultural education curricula does not incorporate problems, potentials and remedial measures of the agricultural sector pertaining to their country. There is a need for substantive evidence on several aspects of agricultural information and production knowledge of producers so that feasible development strategies could be designed. Research in this area in Ethiopia, and probably in many less developed countries, is lacking. The present study is an attempt to fill some of the gap regarding the role of agricultural information and indigenous production knowledge in the design of sustainable agricultural development

strategies in the Central highlands of Ethiopia.

The Study Sites

The research was carried out over a period of 17 months in 1990-1991. The research sites are Selale and Ada districts of the central Ethiopian highlands. These two sites have similar farming systems and belong to the high potential cereal-livestock zone (Kebede, 1993; FINNIDA, 1989).

Selale is representative of the high altitude zone (more than 2000 meters above sea level) of the country. The major crops grown in Selale include oats, teff, barley, wheat, horse beans and field peas. The average farm size is 3.1 hectares, 30 percent of which is used as permanent pasture or grazing land with the rest cultivated. The average livestock holding is 3.5 cows, 1.8 oxen, 0.55 bulls, 1.8 young animals and 2.96 calves (Finnida, 1989). Farmers have extensive experience in livestock production than those in the Ada region.

Ada is characterized by mild weather and represents the country's large middle-altitude cropping zone (1500 to 2000 meters above sea level). The major crops grown include teff, wheat, barley, horse beans, chickpeas and field peas. The average farm size is 2.6 hectares. There is virtually no fallow land. The average livestock holding is 1.28 cows, 1.98 oxen, 0.50 bulls, 0.53 young animals and 0.84 calves (Gryseels and Anderson, 1983). Compared with the Selale region,

Table 1: Selected Characteristics of Selale and Ada Farmers

		Selale		**Ada**			
		N	Average	N	Average	F-Value	Prob>F[1/]
No. of Household Members who are:	Dependent	173	4.47	41	4.29	0.412	0.469
	Independent	207	1.75	48	1.5	4.52	0.03*
Education of Household Head (yrs)		55	2.5	23	3.6	5.671	0.001*
Experience (years):	Dependent	176	11.24	50	13.44	0.044	0.83
	Independent	176	24.58	50	27.88	4.173	0.04**
Income (Ethiopian birr) from Sale of:	Grain	203	230.27	49	828.6	65.46	0.006*
	Livestock & Livestock Products	194	451.4	22	203.11	1.09	0.058**
	Fuel wood	169	343.58	31	63.97	13.84	0.004*
Expenses (Ethiopian birr) for	Purchase of food	214	268.2	50	228.14	2.366	0.125
	Clothing	205	114.49	39	106.09	0.309	0.579
Milk production (in liters) per Month:	Local cows	193	56.9	35	42.6	6.79	0.05**
	Cross-bred cows	66	320.35	14	186.29	5.76	0.011*
Area under (hectares)	Crop	217	2.5	52	2.3	19.56	0.001*
	Grazing	208	0.8	37	0.2	26.29	0.006*
Livestock Number		165	10.89	16	5.18	0.69	0.016*
Crop Production ('00kg)		217	14.88	52	21.41	2.98	0.05**

1/ * and ** refer significance at 1 and 5 percent respectively; the F-values test differences in the average values of socioeconomic characteristics between Selale and Ada farmers.
2/ Household members who are capable of working without supervision are categorized as independent or "workers" (age 15-60) and those who have to be supervised are considered dependent or "consumers" (age <15 and >60).

Ada farmers specialize more in crop production in which they have extensive experience.

A summary of selected socioeconomic characteristics of farmers in both study sites is presented in Table 1. The statistical analysis of this profile suggests that the two regions exhibit statistically significant differences with respect to the: I)number of household members who are independent, ii) number of years of schooling, iii) number of years of farming experience as an independent farmer, iv) number of livestock owned, vi) average income received from the sale of grain, livestock and fuel wood, vii) crop and grazing area, viii) amount of milk produced per household and ix) amount of grain produced (Table 1). The wealthier household is the better able he/she is to acquire information from formal and informal sources.

Ada farmers had more years of schooling and more years of farming experience. They gain most of their income from the sale of grain while Selale farmers rely mostly on sales of livestock and livestock products. The productivity of livestock (milk/cow) is higher among Selale farmers while Ada farmers produce greater crop yields per hectare.

Design of the Study

Several crop production technologies are introduced in the study sites since the 1960's. However, introduction of cross-bred cows took place not only recently but also implemented by different agencies with relatively different approaches to technological introduction. Furthermore, this research was conducted to provide information on the socioeconomic feasibility of cross-bred cows. Therefore, it was felt appropriate to compare farmers who have adopted cross-bred cows (test) and those who did not (Control). These farmers may have adopted

any combination of crop-production augmenting technologies.

Households which received cross-bred cows and were selected for this study in the Ada and Selale areas numbered 26 and 89 respectively.[1] A confidence level of 95%, coefficient of variation of crop and milk yields of 96 percent and precision level of ± 20% resulted in a sample size of 89 farmers for the Selale region. For the Ada region, however, time and financial resources limit the number of test farmers to only 26. Comparison of average values of socioeconomic variables derived from a district-wide survey by the Ministry of Agriculture and average values of similar socioeconomic characteristics calculated from test farmers showed that the two data set are approximately the same. Therefore, the small sample size for the Ada region will not bias the foregoing analysis.

After determining the sample size, the need to use farmers who joined various programs as test groups necessitated the use of systematic selection of the control group.[2] A method was designed such that all test farmers were compared with farmers who exhibit similar socioeconomic characteristics (control farmers) but were different in ownership of cows (for details see Kebede,1993).

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[1] Prior to selection of the control group, the sample size was determined according to the following procedure. The sample size (N) is given as: $N= (KV)^2/D^2$, where D is the largest acceptable difference (in percent) between the estimated sample and the true population parameters. K is a measure of confidence (in terms of the number of deviations from mean) with which it can stated that the result lies within the range represented by plus or minus D and V is the coefficient of variation of yields.

[2] The programs in question were those operated by the International Livestock Centre for Africa (ILCA), FINNIDA (Finnish International development Agency) and MOA (Ministry of Agriculture, Ethiopia).

The control farmers were to have a comparable number of oxen, cows, sheep/goat, family size, age (farming experience), education, annual farm income and farm size (crop and grazing) with the test farmers. Moreover, the two groups had to exhibit similar ethnic, climatic and geographical characteristics. To accomplish this task, a three-step procedure was followed. Firstly, a group of farmers involving political leaders and elders in each peasant association were asked questions such as, "With whom do you think farmer "A" compares with respect to income, livestock holdings, living standard, etc., except that he does not own cross-bred cows?".[3]

Secondly, each test farmer was asked questions such as, "To whom do you think you are comparable with respect to income, livestock holding, family size, etc., except that you own cross-bred cows and the other farmer does not?". This method of identify a control farmer is difficult and socially controversial.[4] Nevertheless, it would provide a clue to identifying control farmers.

Thirdly, 150 farmers who did not receive cross bred cows were interviewed with respect to the above socioeconomic characteristics. The results were compared with background socioeconomic data obtained from test farmers. Combination of the above three steps enabled identification of control farmers that were used in the present study.

Selale farmers were instructed that inputs necessary for the management of cross-bred cows were available in their locality, and that they should take full responsibility for the

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[3] A peasant association is a geopolitically delimited association of peasants covering an area of about 400 hectares. Political leaders are farmers who, through democratic election processes, were elected to take administrative positions within a peasant association.

[4] Evaluating the economic well-being of other farmers would force farmers to think as if they were intruding into private life of others. This is not a socially acceptable norm. However, options were explored with groups of farmers and they suggested that this method could be feasible if used in conjunction with step one.

management of such cows. Farmers in the Ada area, however, joined the ILCA technology diffusion program voluntarily because it provided a relatively risk-free environment (e.g., subsidized cost of feed). The approach to diffusion of technologies in the Selale region, therefore, is different from that implemented in Ada area. Comparative analysis of the two sites is hypothesized to reveal significant differences in types and sources of information, and production knowledge of households in the two study sites.

Methods of Analysis

The present study examines types, sources and accessability of information, as well as production knowledge of households in Ethiopia. To accomplish this task multidisciplinary research methods are employed. Specifically, anthropological, cognitive psychology and agricultural economics research methods are employed in this study.

Open ended questionnaire was administered to test and control farmers in the Ada and Selale regions of Ethiopia (Kebede, 1993). The responses to the questions were tabulated, and measures of central tendency (e.g., mean and standard deviation), frequencies and percentages were computed for responses related to information.

The goals and resource allocation strategies of households depend on the production knowledge possessed by households. There are no hard and fast rules to measure or quantify production knowledge. Studies in cognitive psychology have demonstrated the usefulness of measuring knowledge using problem solving tests or comprehension ability (see Eisemon, 1988; Bransford and McCarrel, 1983). Causal attribution or explanation of reasons for a specific problem have also been found useful (Eisemon, 1988). Moreover, routine observation and

participation in field activities with study farmers were used to validate information collected through questionnaire.

To assess and measure agricultural knowledge, two approaches were employed in this study. First, problem solving tests were constructed to measure agricultural knowledge and skills related to current production techniques and practices. The tests were intended to examine the kinds of solutions households provide to crop and livestock production problems based on their agricultural knowledge.

Secondly, participatory evaluation of indigenous production knowledge and discussions were carried out. Conversations related to production knowledge of farmers while participating in various farming activities were taped and analyzed using flow charts involving causes and solutions or remedies.

Answers obtained from problem solving tests were scored to compare variations in farmer's production knowledge within and between regions. The basis for scoring were answers obtained from discussions with farmers of different age-groups. The premise behind this basis for scoring was that experience and indigenous knowledge vary by age. For the answers or solutions to reflect actual problems of farming in the regions, therefore, it was important to have a consensus from group discussions with farmers of different age groups.

Production knowledge is influenced by several factors. These may include information, wealth, experience, years of schooling, number of relatives, and proximity to cities or markets (measures of awareness). To explain variations in indigenous knowledge, a regression analysis is performed. However, scores of indigenous knowledge lie within the 0-10 interval. That is, it is a truncated continuous variable. Under this situation, classical regression analysis will result in

estimates outside the 0-10 interval (Maddala, 1983). Thus, the following procedure is employed.

Values of production knowledge are normalized such that their value would lie between 0 and 1. The logit model is formulated as:

$$P_i = F(X_i) = \frac{1}{1 + e^{-(\alpha + \beta X_i)}} \quad \text{..... (1)}$$

Taking the logarithms of both side,

$$\ln (P_i) = \alpha + \beta X_i + U_i \quad \text{..... (2)}$$

where P is truncated continuous dependent variable (i.e. production knowledge), α and β are unknown parameters, X's are independent variables and U's are disturbance terms. The independent variables include experience (years), education (years), index of exposure to outside information, extension education (number of visits by agents), wealth (values of crops produced and livestock owned, in Ethiopian birr), region (0-1 variable), proximity to infrastructural facilities such as schools and road (0-1 variable), number of friends in a village or peasant association. The wealthier household is the better able he/she is to acquire information from formal and informal sources. The index of awareness was measured as:

$$\text{Awareness} = [C_1 + C_2]/2 \quad \text{..... (3)}$$

Where C_1 is relative number of city visits measured as the number of visits a farmer makes to the nearby town and market places per year divided by the highest number of visits in the sample. This way the ratio (C_1) is constrained to lie between 0 and 1. Owning radio (C_2) was given a value of 1 and 0 otherwise. A farmer who owns a radio is assumed to listen to news from outside the vicinity and thus expected to have a 100 percent exposure to outside information compared

to farmers who do not own radio. Although owning radio is discrete and city visit is continuous (between 0 and 1), the need to capture the influence from both sources and at the same time to reduce the number of variables necessitated the construction of this index.

Farmers were asked to value how close they are to schools and road, and related service centers as close or far. Respectively, a value of 1 is assigned if they are live close to infrastructural services and 0 otherwise.

Results of the Field Research

Types and Source of Information

The type and sources of information of households in Selale and Ada region are presented in Table 2. Households gather information from formal or informal sources (Belay, 1977). Formal sources include schooling, extension agents, radio, newspapers and magazines. Informal sources include experience, interaction with friends, relatives, and children (Table 2). Although

subjects may identify sources of information, the most difficult aspect of information is obtaining access to it (Warren, et al., 1989). Most farmers in Ethiopia have not attended secular school, don't own a radio or do not have access to magazines and newspapers. Most farmers gather information from families and friends. However, if the type of information relates to new production techniques, extension agents would be the major source of information (Table 2).

Table 2 . Types and Sources of Information in Selale and Ada Regions

	Percentage of Farmers receiving[1]			
	Information from			
Types of Information	Extension Agents	Families	Friends	Other Sources[2/]
Crop Production:				
Pesticides Use	20(40)	30(10)	35(15)	15(35)
Rotation & fertilizer	10(45)	45(20)	30(15)	5(20)
Crop Protection	15(41)	35(10)	40(14)	10(35)
What to plant	0(5)	65(30)	35(20)	0(45)
Soil type	0(10)	55(15)	45(15)	0(60)
Texture and depth	0(15)	48(10)	52(10)	0(65)
Improved seed	25(35)	20(18)	45(12)	10(35)
Fertilizer	55(60)	20(25)	10(5)	15(30)
Livestock Production:				
Better management	10(20)	45(40)	35(30)	10(10)
Forage production	60(10)	0(45)	40(15)	0(30)
Disease control	10(15)	58(10)	22(18)	10(57)
Use of A.I.	35(10)	0(15)	45(15)	20(60)
Cross-Bred cows	60(61)	21(24)	11(8)	8(6)
Marketing:				
When to sell	0(5)	50(55)	30(35)	20(5)
How to sell	0(8)	60(61)	30(21)	10(10)
What to sell	0(10)	90(75)	10(10)	0(5)
Where to sell	5(15)	65(80)	25(5)	5(0)
Home Economics:				
Few children	55(45)	0(5)	45(15)	0(35)
Clean house	35(50)	65(18)	0(5)	0(27)
Use of latrine	55(45)	0(10)	0(10)	45(35)
Child care	40(35)	50(15)	0(15)	10(35)
Dividing the house	45(30)	55(10)	0(5)	0(55)
Soil & Water Conservation:				
Fallowing	0(5)	65(5)	35(10)	0(80)
Terrace	10(5)	55(5)	30(5)	5(85)
Furrows	0(10)	40(4)	55(6)	5(80)
Overturning green plants	0(15)	55(5)	45(5)	0(75)
Sample Size	115(50)	115(50)	115(50)	115(50)

1/ Values in parenthesis are for the Ada region. 2/ This group includes newspapers and magazines, other government agencies and development projects.

Most Ada farmers receive crop production information from extension agents, magazines, other government agencies and development projects. On the other hand, Selale farmers depend on family and friends for information on different aspects of crop production.

With respect to livestock production, Ada farmers spread their sources of information between families, friends and other sources. However, Selale farmers selectively use extension agents, families and friends as sources of information.

Marketing information is obtained mainly from families and friends. Information on home economics is obtained from extension agents and families (Selale) and extension agents and other sources (Ada). Selale farmers depend on families and friends for soil and water conservation information while Ada farmers on other government agencies and development projects.

Access to information indicates that test farmers are visited more frequently by extension agents, other government agencies and development projects compared to control farmers in both study sites (Table 4). A sharply contrasting difference is observed between the number of contacts that Ada farmers have with other government agencies and projects compared to Selale region. If knowledge is influenced by types and sources of information, formal sources would contribute most to production knowledge next to experience.

Table 4. Sources of & Access to Information Among Study Farmers

	Categories of Farmers			
	Selale		**Ada**	
Categories	Test	Control	Test	Control
Aver. Frequency of				
Extension Visit/yr	19	10	17	8
Market visit/month[2/]	2	2	3	3
City visit/month[3/]	2	2	4	4
Owning/listening radio4/	2.5	1.5	1	1
Experience (yrs)[5/]				
Dependent	12	15	11	14
Independent	26	23	23	22
Contacts with Development agencies	25	12	8	5
Other projects	15	8	12	8
Sample Size	50	50	156	150

Source: Computed from field survey, 1990/91.

1/ Some farmers did not gave answers to questions related to market and city visits. Thus, the effective sample size was less than 50.
2/ refers to the average number of days that members of a household travel to a nearby city.
3/ refers to the average number of days that members of a household travel to a nearby market place either to purchase necessities, sell farm outputs, or both.
4/ If a household owns and listens to a radio a value of 1 is given and 0 otherwise, the figures indicate average values.
5/ Dependent- refers to the number of years a household head spent working for his/her parents, and independent refers to the number of years of farming experience after a household head became an independent farmer or after marriage.

Group discussion, as a source of information, was carried out to assess how information is diffused and whether or not there are variations among households and villages. At the district level, differences in access to information is the result of government policy. Man-power, services and supplies provided through the Ministry of agriculture are biased towards' surplus grain producing regions (see also MOA, 1989).

Information from extension agents tended to favour peasant associations that are closer to cities whose officials have developed strong friendship with extension agents (Table 5). Most farmers in the Ethiopian highlands live more than five kilometer away from the main roads. A substantial amount of money is needed to cover traveling costs for extension agents in order to reach these farmers. Thus, extension agents visit farmers who live closer to major roads and cities. Furthermore, producers who have directly or indirectly developed stronger friendship with extension agents obtain more information than farmers who have not developed such contacts.

Indigenous Knowledge

The study sites represent the mixed farming systems that dominate the Ethiopian highlands. Variations in knowledge between regions and farmers are illustrated with respect to crop and livestock production.

Crop Production Knowledge

Producers use their knowledge to comprehend ideas and to construct causal linkages and relationships prior to choosing actions. The results of inferential reasoning or actions chosen by

Table 5: The Effect of Distance and Political Representation on Frequency of Visits of Extension Agents

PAs (in Selale)	Distance From Cities or SCs (kms)	Intimacy of Officials with DA's	Frequency of visit/month
Gulele	1.5	High	21
Anokere	3	High	24
Wayu	2	High	28
Illukura	17	Low	12

Where DA, PA, SC refer to development or extension agents, peasant association, and service cooperatives respectively. A peasant association is a geopolitically delimited association of peasants covering an area of about 400 hectares. Political leaders are farmers who, through democratic election processes, were elected to take administrative positions within a peasant association. A service cooperative is an association formed by a group of PA's for the purpose of providing services such as consumer goods and production inputs at less than market prices to members of PA.

households cannot be anticipated a priori for all kinds of problems. For commonly occurring problems, some required actions are part of the norms of the society. There is, however, a body of knowledge specific to households. This specificity may create inequality in production knowledge and management styles, consequently in the efficiency of production. Variations in responses to production problems are presented in Table 6 (see also Guyer, 1986; Lipton, 1977; Kebede, 1993).

Environmental degradation is the result of continuous and intensive extraction of resources. The manner in which resources are used is determined by the availability of choices. For instance, availability of cross-bred cows that produce more milk and oxen with greater traction power than local breeds would provide an incentive to reduce the large and less productive local breeds. Techniques to conserve soil moisture would minimize the risk of crop failure and consequences that follow. Table 6 indicated problems, choices and failure of resources to provide subsistence requirements (see Huffnagel, 1961; MOA, 1975; Gafsi, 1976; Perrin, et al., 1976; Kebede, 1993). Dissemination of information regarding the management of resources has to be preceded by examining what producers know and design of mechanisms for the transfer of information that would

Responses ranging from access to information or training to problems of livestock production are tabulated in Table 7. In the Ada area, extension efforts towards "improved" methods of production are biased against control farmers. For instance, training in general livestock production methods is given to sixty percent of the test and thirty percent of the control farmers (Table 7). Most farmers in the Ada area region and control farmers in both study sites

Table 6: Percentage Response to Knowledge Oriented Problems

Items	**Selale**		**Ada**	
	Test	Control	Test	Control
1. Fertile soils are those which are				
Black	89	82	91	96
Others	11	18	9	4
2. Do not use crop technology because:				
Lack of money	55	51	78	71
Lack of access	22	30	15	24
God's punishment	23	19	7	5
3. Why grow many crops: Survival	61	75	80	92
4. Criteria to choose seed:				
Market value	10	15	20	17
Soil-crop r/ship	15	16	5	5
Crop-plot r/ship	20	14	6	7
Policies	15	10	20	20
Food value	40	45	49	51
5. Apply fertilizer/pesticide on:				
Teff	30	9	80	92
Wheat and barley	70	91	20	8
6. Adopt innovation if:				
It increases production	70	81	98	94
It is less risky	20	11	2	6
Others	10	8	-	-
7. To improve fertility:				
Use fertilizer	22	20	80	84
Fallow/furrow/soil burning	70	70	-	-
Rotation	8	10	20	16
8. Heard alternative to reduce Moisture Variability				
Yes	18	19	52	58
No	82	81	48	42
9. Problems of crop production are:				
Locust, storm, worms, rain	79	81	94	97
Others	21	19	6	3
10.To reduce yield variability:				
Use terrace,less seed rate, Furrow and Overturning	40	55	71	79
Praying	60	45	29	21
11. If crop fails then: Reduce Consumption	18	22	42	54

Table 7: Percentage Response to Knowledge Oriented Problems

Items	**Selale**		**Ada**	
	Test	Control	Test	Control
1. Gain training in:				
Livestock production	68	45	60	30
Crop production	47	53	53	61
2. Obtain knowledge of better Livestock Production Methods:				
Extension agents	5	5	4	3
Education	15	10	21	19
Experience	80	85	75	78
3. Choice breeding stock based on:				
Traction	50	55	90	89
Reproduction/milk	45	35	8	10
Colour	5	10	2	1
4. Which to sell:				
Milk	53	66	81	72
Butter	47	34	19	28
5. How much to sell:				
Milk produced	70	81	60	64
Market price	10	5	10	5
Ability to purchase feed	-	-	-	-
Need cash	20	14	30	31
6. Adopt cross-bred cows if it:				
Increases in milk, good traction, resistant to disease, feed and veterinary	85	91	89	98
7. Decision criteria on how to using Cross-Bred Animals:				
Height of calves, traction				
reproduction ability	50	82	78	91
Milk Produced	50	61	78	69
8. Effect of using local bulls:				
Less growth/traction	20	15	50	65
Less butter	80	85	50	35
9. Method of controlling Animal Disease:				
Vaccination	5	5	35	30
Traditional	60	75	45	55
Vaccination and traditional	35	20	20	15
10. Solution to livestock production Problems:				
Feed	9	12	5	16
Feed and veterinary	91	88	95	84

evaluate several factors to decide how to use cross-bred animals. Test farmers are more willing to take risk embodied in new technologies. One possible explanation is related to biases in information transfer that favour test farmers.

Selale farmers have an immense knowledge of livestock production. Three important observations in the management of cross-bred cows in the Selale region are provided as examples. The first observation is related to decisions regarding whether or not to sell fresh milk. The second observation is concerned with the effort farmers put into the management of cross-bred cows. The third observation is related to reasons for the susceptibility of cross-bred cows to disease and measures that some farmers implemented.

The farther a farmer lives from the milk collection centers, the less the amount of fresh milk he/she sells. Most of the milk from cross-bred cows is given to calves or to children. However, milk from local cows is entirely processed because of the higher butter-fat content (Table 8). Most of this butter is sold at local market or itinerary traders. At this distance, services from breeders and veterinarians are less accessible. Producers, therefore, depend on the revenue from the sale of the offspring of cross-bred cows to repay loans rather than on income from the sale of fresh milk. If a farmer lives close to the milk collection centers, he/she sells most of the milk obtained from cross-bred cows fresh. The largest percentage of milk from local cows is processed with increases in distance from collection centers or highways (Table 8).

The farther a farmer lives from the milk collection centers, the less care and management effort he/she puts into cross-bred cows. In fact, some producers feed their local cows equally or better than the cross-bred cows. On the other hand, the closer a householder lives to the milk

Table 8: Strategic Management of Milk Production and Disposition

	Peasant Associations in Selale			
	Wayu	Segokara	Gendesheno	Illukura
Distance from Milk Collection centre(km)	3	5	7	13
Percentage of milk from Cross Bred Cows:				
Sold	94	71	60	15
Processed	2	20	28	55
Consumed	4	9	12	30
Percentage of milkfrom Local Coews:				
Sold	15	11	5	1
Processed	77	82	91	98
Consumed	8	7	4	1
Farmers interviewed	8	13	8	6

collection centers, the more effort he/she puts into proper care of cross-bred cows in comparison to local breeds. This calculated behaviour of households is reinforced by the frequent visits of extension agents to households located close to the milk collection centers (see also Tittarelli, 1990).

Finally, participatory study of test farmers revealed that the size and colour of cattle influence the degree to which they are attacked by disease-causing organisms. According to the study farmers, cross-bred cows are larger and posses visible colour (black and white). They attract insects and birds which may carry disease causing organisms. Therefore, they prefer to keep cross-bred cows in stalls or in less visible colours (e.g., grey).

Causal Attribution and Problem Solving Tests

It is argued that education, as a source of information, helps to understand and provide solution to day-to-day problems (Warren, et al., 1989). To examine the influence of education and age on the ability of households to provide causes, indicators and solutions to production problems, four representative farmers with different years of farming experience and education were selected.

The results of causal attribution indicate that farming experience influences knowledge about causes, indicators and solutions to production problems. Education helps a farmer to relate production problems to experience and outside information, and hence provides a more comprehensive set of indicators and solutions to production problems (see Kebede, 1993).

Quantifying Production Knowledge

Differential access to information is expected to be reflected in differences of knowledge regarding production and marketing of agricultural products. To establish a benchmark for comparing answers given by households, the questions were directed to a group of fifty farmers whose ages range between 18 and 65. A score of 1 to 10 was prepared. Answers given by each farmer were rated relative to those given by the group.

The result of frequency analysis of production and marketing knowledge are presented in Table 9. The result indicates that in most cases test farmers scored higher than the control group.

Knowledge possessed by households varies by age. Children are brought up to be good farmers. To illustrate this case, 42 farmers with different years of farming experience were selected and asked to respond to production related questions (see Kebede, 1993). A score, as indicated earlier, was prepared (Table 10).

The score from problem solving tests increases at a faster rate until the number of years of farming experience reaches 25. It should be noted that there is no one-to-one correspondence between farming experience and knowledge. Nevertheless, experience contributes much more than other sources to the repertoire of indigenous knowledge. It means that knowledge gained over a number of years attains its maximum effect when producers are in their 40's (about 25 years of experience). The young generation (18 to 30) visit cities and markets frequently, and interact with people who have attended secular schools. Group discussions indicate that this is one of the reasons for the relatively high score of marketing knowledge by the younger compared to the older farmers. One contrasting difference between regions is that crop production

Table: 9. Differences in Knowledge and Access to Extension Service)

	Categories of Farmer				
Categories	Test	Control	Test	Control	Sample Size
Knowledge (score/10)					
Crop Prod. Knowledge	9	9	8.5	7.5	261
Livestock Production Knowledge	7	6	9.2	8.1	265
Marketing Knowledge	8	8	5	6	264
Total	22	21	20	20	

Table 10: Scores of Problems Solving Tests By Region

	Selale Region			Ada Region			
	Type of Knowledge			Type of Knowledge			
Experience (Years)	Crop Production	Livestock Production	Marketing	Crop Production	Livestock Production	Marketing	Number of Farmers
5	5	6	7	6	4	7.5	4
10	5.5	6	7	7.5	5.2	7.9	5
15	6.2	7	6.5	8	5.3	8.1	4
20	6.8	7.1	7.2	9.1	5.5	8.4	12
25	8.1	8.2	8	9.4	5.8	8.9	2
30	8.5	8.5	8.4	9.5	6.4	9.1	5
35	8.7	8.8	8.5	9.7	6.5	9.4	7
40	9	8.9	8.8	9.8	6.6	9.5	4
45	9.1	9	8.9	9.8	6.8	9.6	3

knowledge is not only high but also increases at a faster rate among Ada farmers while this pattern holds true only for livestock production knowledge among Selale farmers. Marketing knowledge is relatively high among Ada compared to Selale farmers, due to proximity of the former site to the capital city. Similar patterns are observed among farmers whose interest is in livestock production.

Explaining Production Knowledge

The result of logit regression for indigenous knowledge are presented in Table 11. The findings indicate that experience, education, exposure to outside information, wealth and number of

friends greatly influence variability in indigenous knowledge. Information regarding the management of resources can have its greatest impact if formal sources (e.g., education and extension agent) relate to experience or indigenous knowledge.

The present study strongly believes that the absence of this link between projects and beneficiaries (farmers) is the major cause of resource or environmental degradation. That is, the information contained in new technologies or disseminated by intervention strategies do not recognize a pre-constructed context of thinking or method of information processing skills of farmers. Moreover, information that is passed on in a top-down prescription would make farmers less knowledgeable and devoid a means of empowerment. If indigenous knowledge and the potential of producers to process information is not considered as a power full in directing human actions, it is inconceivable to attain environmentally sustainable development.

Table 11. Results of Logit Regression of Determinants of Production Knowledge

	Intra-Region		Selale		Ada	
Variables	Selale	Ada	Test	Control	Test	Control
Intercept	1.178	2.233	1.788	3.213	1.202	3.155
	(3.079)*	(4.112)*	-2.452	(4.014)*	(1.903)#	(3.02)*
Experience	0.516	0.594	0.616	0.816	0.662	0.84
	(2.762)*	(1.97)#	(3.099)*	(3.825)*	(2.97)*	(3.05)*
Education	0.373	0.401	0.503	0.365	0.528	0.365
	(2.02)#	(2.071)#	(2.199)*	-1.223	(2.675)*	-1.91
Awareness	0.595	0.692	0.463	0.43	0.512	0.502
	(3.666)*	(3.65)*	(2.34)*	(1.96)#	(2.55)*	(2.27)*
Extension Educ.	0.279	0.265	0.049	0.179	0.212	0.226
	-1.08	-1.94	-1.003	-1.07	-1.182	-1.65
Wealth	0.499	0.369	0.453	0.59	0.748	0.577
	(2.39)*	(2.19)#	(2.734)*	(2.351)*	(2.28)#	(2.18)#
Region	0.343	0.41	0.267	0.176	0.198	0.493
	-1.859	(2.03)#	-1.064	-1.204	-1.733	-1.39
Proximity to Infrastrucuture	0.264	0.193	0.201	0.195	0.294	0.209
	(2.984)#	-1.785	-1.346	-1.459	-1.849	-1.95
No of Friends	0.54	0.493	0.547	0.488	0.395	0.534
	(2.495)*	(2.456)*	(2.794)*	(2.77)*	(2.09)#	(2.73)*
N	217	52	114	89	27	26
Chi-Square	47.9*	46.3*	50.1*	51.3*	25.4#	45.9*

* and # indicate statistical significance at 1 & 5 percent respectively.

Summary

Observatory, participatory, logical explanation and logit analysis were employed to investigate types, sources and access to information, and determinants of agricultural production knowledge among peasants of the Central highlands of Ethiopia. Households gather information from formal and informal sources. Information from extension agents tends to favour producers and peasant associations which are close to cities, service cooperatives, politicians and extension agents. Test farmers have greater access to sources of information than control farmers.

Test farmers and politicians received higher scores on problem solving tests than control farmers. Households who are young living closer to big cities and market centres gain larger scores on marketing knowledge. The results of causal attributions or explanations to day-to-day problems indicate that education helps to relate production problems to experience and outside information, thus enabling a comprehensive examination of production problems.

Households in the Selale area received higher scores in livestock production problems while that of Ada farmers in crop production problems. Production knowledge varies by age. Experience, education, friends and exposure to outside information greatly influence indigenous knowledge. Securing subsistence food requirements and sustainable resource management can be had if the skill with which producers process information and the potential of indigenous knowledge are integrated in designing intervention strategies. Long-term plans should also include strategies to related externals sources of information such as extension and secular education with indigenous knowledge.

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