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A LOW COST APPROACH TO UNDERSTANDING SMALL FARMERS*

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SUMMARY

The case for a farming systems approach to agricultural improvement is made. Elements of the CIMMYT field investigation procedure are outlined, including zoning into homogeneous recommendation domains and evaluation of farmers' social and economic circumstances. Details of the exploratory survey and subsequent field verification procedures are outlined. Detailed guidelines for field surveys, as tested in Zambia, are provided as an Appendix.

INTRODUCTION

Understanding the way in which the farmer weighs information on rainfall, soils, markets and available production techniques and then allocates his resources to provide reliable food supplies and cash incomes is the key to understanding the small farmer. This systems view, in turn, is the key to relevant research and development efforts which seek to realise national policy objectives whilst, at the same time, providing farmers with improved production techniques to better satisfy their own needs and priorities.

THE NEED FOR A LOW COST APPROACH TO UNDERSTANDING SMALL FARMERS

Farming Systems Research (FSR) is a 'natural' for achieving an understanding of small farmers. Established approaches to FSR in developed agriculture require professional input at the farm level in investigation, planning and advice (Collinson[1,2]). Like other applied disciplines faced with the classic small farmer

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problems—low returns from attention to individual farms and high opportunity costs due to poor coverage when scarce professionals are focused on individual farms—FSR has had to evolve new approaches and methods to be useful in this context. It has taken almost twenty years for alternatives to crystallise.

One breakthrough was the use of the representative farm model, more meaningful in traditional agricultural sectors than in advanced agriculture. It allowed a breakaway from the need to deal with the individual farm in the investigation and planning stages. However, modelling of the real world is too complex for the techniques at our disposal and the costs of measurement of the input and output coefficients, in terms of limited professional time, are extremely high. A conflict remains between intensity of professional input on a proportion of the traditional sector and coverage of that sector.

Agricultural research has been the major provider of new technology to the traditional sector and its historical orientation was on commodity and disciplinary lines. However, recent efforts have focused the use of *a systems perspective* to identify researchable problems and opportunities among small farm populations as the operational niche for FSR. It has been increasingly recognised that a systems perspective has two major advantages:

(1) It allows an understanding of how and why the farmer, in managing several enterprises, makes compromises on the optimum technical management of any one enterprise.
(2) It allows the application of wider, more relevant, productivity criteria in the design of new technology than the limited criterion of physical yield per unit of land area beloved of classical agricultural research.

A systems perspective can be brought to bear without a detailed manipulation of numbers in a modelling format. Understanding is, in fact, a prerequisite to building useful models which, at best, can improve that understanding. Applying a systems perspective by a low cost, almost anthropological, approach allows an initial understanding. This may then be improved with detailed data collection and manipulation by a systems technique. However, the direct costs of this improvement in understanding are high and the opportunity costs of the additional professional time are even higher. The benefits from the extra understanding of one target population have to be set against the benefits of an initial understanding of perhaps four other target populations. At this stage in the application of FSR the benefits from wide coverage of small farmer populations dramatically outweigh those from a more intensive, numerate approach with much narrower coverage.

SOME FACETS OF ONE LOW COST APPROACH TO UNDERSTANDING SMALL FARMERS

CIMMYT has developed a low cost approach to understanding small farmers in an effort to improve the relevancy of the technology emerging from experimental work

(CIMMYT[3]). The approach seeks to understand the farming system and how the resource requirements of the system as a whole necessarily compromise both present management and potential management improvements for a target crop. The focus on a pre-specified target crop reduces the investigational work and is consistent with the existing commodity orientation of many National Agricultural Research organisations. The concepts, forming the basis of the approach, were crystallised in 1975, and a methodology was outlined to allow its implementation. The methodology has been refined in the course of demonstrations of the approach to interested National Agricultural Research Programmes by CIMMYT Regional Economics Programmes operating in the Andes, Eastern Africa, Central America and the Indian sub-continent. (See for example, reference 4).

Zoning

To create a preliminary framework for the ordering of priorities and the focusing of research efforts, farmers are grouped into relatively homogeneous populations on the basis of their present farming system. CIMMYT terms these target population groups 'Recommendation Domains'. The farming system as a criterion for such groupings has three justifications:

(a) Their existing farming system is a manifestation of a weighted interaction of natural, economic and historical factors influencing farmers' decisions. It reflects the balance of factors important in identifying homogeneous groups of farmers.
(b) The existing farming system is the starting point for development, the base on to which productivity improvements have to be grafted.
(c) Farmers with the same farming system have the same priorities and resource endowments and thus the same researchable problems and development opportunities.

Grouping farmers on the basis of present activities has two dimensions; activities alter geographically with changes in the natural and economic environment and hierarchically with changing resource endowments. Both dimensions are important to present and potential crop management. The method is described as applied to Central Province, Zambia, an area of 116,000 km^2 with a population of some 345,000 (reference 4, 1979 data).

The smallest administrative division in Zambia is the ward. There were 72 rural wards (1975 boundaries) in Central Province, averaging about 1000 households each. Information collected at the ward level is aggregated into relatively few farmer groupings and the aggregation process smoothes out small inaccuracies arising in the ward level information. For programme implementation purposes the resulting groupings can be specified in terms of districts and wards—units already in use in agricultural planning and administration.

A questionnaire was developed to collect descriptive information about farming in the wards. This questionnaire is shown in Fig. 1. It sought to tap the experience of

District_____ Ward No._____ Farmer Group_____

A. Animals kept by *most* farmers	1. Three main types of animals kept	1 2 3
	2. If cattle; main purposes for keeping	1 2 3
B. Foods *grown* (*G*) *or bought* (*B*) by *most* farmers	1. Starch staples	1 2 3
	2. Relish crops to flavour staples	1 2 3
	3. Animal products for food	1 2
C. Main cash sources for *most* farmers (overall rank)	1. New cash crops and % growing	1 2
	2. Crop sales as a cash source	1 2
	3. Livestock as a cash source	1 2
	4. Off farm cash source	1 2
D. Land use methods and time of most farmers	1. Years cultivated	1
	2. Typical area (ha)	1
	3. Main methods of land preparation	1 2
	4. Main months of land preparation	1 2
E. Hire and purchase of resources by most farmers	1. Types of hired labour and payment	1 2
	2. Work done by hired labour	1 2
	3. Main inputs purchased and crops using	1 2 3

Fig. 1. Farm system zoning questionnaire, Central Province, Zambia.

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agricultural staff locally involved in day-to-day agricultural administration in the areas to be covered. Foreknowledg of their likely biases was used to try to ensure balanced information. For example, the current and post extension programme content was known and both input sales figures and marketed output figures were obtained and related to estimates of overall crop areas and population to give an idea of the degree of penetration of extension efforts and degree of market activity. This knowledge is used to prompt extension staff who tend to generalise from their (usually) low proportion of co-operating farmers to the area and population as a whole. Data collection was organised through the four District Agricultural offices in the Province. The questionnaire was administered by the research economists to Station Officers; that is, agricultural extension staff, each in charge of 5–10 wards and with several Camp Officers subordinate to them.

Before the survey proper the questionnaire was tested in two locations to evaluate the relevance of the questions and to improve the phrasing in putting the question to the respondent. During the survey proper the economist first discussed the wards with the District Agricultural Officer, seeking information on:

(a) The proportion of traditional, emergent and large-scale farmers in the ward. a hierarchical division already recognised by the Ministry of Agriculture.
(b) For each of these farmer categories:
    (i) The main power source used.
    (ii) The approximate typical area cultivated.
    (iii) The main crops grown for food and for cash.

This initial information was used as a check on Station Officers responding to the detailed questionnaire for each ward. Discrepancies were identified and taken up with the Station Officer concerned. If he stuck to his response the discrepancy was taken up with the District Agricultural Officer.

Several approaches to data tabulation were tried to facilitate interpretation. A straightforward tabulation is essential. Its value for interpretation is enhanced if, as far as possible, wards which are contiguous on the ground are also contiguous in the Table. Some compromise is inevitable. The ordering of the ward data in the Table is helped by drawing a grid on the ward maps. The wards are numbered as they are touched by the grid moving either north to south or east to west. Two other approaches to tabulations followed the identification of the major sources of variation between wards in different parts of the Province. First, information on these major sources was written on to the map in each ward to help crystallise the boundaries between zones. The second approach was to build 'trees' on the main sources of variation. For example, wards were first grouped on the basis of power source. These groups were then split on the basis of the main starch staple food; these subgroups were split on the basis of major cash sources, and so on. The process is easiest if wards are first grouped on variables which have fewest categories. The process gets too complex after three or four variables have been considered but helps

Zambia.

to improve the understanding of sources of variation which are related. The key step is deciding which sources of variation are critical in dictating resource allocation in the farming system of the area. Identifying these key variables reduces the collected information to manageable proportions.

The costs of identifying target populations for Central Province, using this methodology, were low. In terms of professional mandays three stages can be distinguished.

(a) Preparation: 6–8 mandays
  (i) Developing and testing the questionnaire.
  (ii) Arranging the programme of district visits.
  (iii) Preparing background material and maps.
(b) Data collection: 6–10 mandays
  (i) Administering a questionnaire for some 100 ward/farmer category combinations to some dozen station officers called in to their District Offices.
(c) Domain identification: 8–12 mandays
  (i) Tabulation of the collected data (can be done by clerks).
  (ii) Interpretation of the data.
  (iii) Deriving, describing and mapping Recommendation Domains.

Some 20–30 professional mandays are required for the whole exercise.

Allowing for the need to arrange Station Officers' meetings, to travel to District offices, and for delays in mapping, a turn-around time of two months for some 100 enumeration units is feasible. The other three stages of the diagnostic sequence are mounted within each target population identified by this zoning process, in an order of priority indicated by policy objectives.

The evaluation of local circumstances

Accepting the rationality of the small farmer and aware of his needs and priorities, an evaluation of the local circumstances within which he must operate identifies many of the management problems posed by his production environment. It establishes a context within which to interpret his choices of product, of management strategy and of production techniques.

Every self-respecting Farming System Researcher will hoard references to sources of secondary information on the natural and economic conditions in his area of responsibility. A review of the relevant references for the area covering the current target group of farmers should be one or two days' work. A further two or three days in the area talking to local officials will provide a great deal of insight, particularly into economic and institutional conditions. The focus of the enquiry is consistently that of how these local conditions will influence farmers' management decisions. For natural conditions the interest will be in the limitations imposed on production methods and in the uncertainties arising from rainfall variation and frost, pest and disease incidence. For economic conditions the interest will be in the cash earning

opportunities available, the uncertainty created by price variations, the services available and whether the institutions involved penetrate the target group effectively with a reliable and timely service.

As an example clues to management problems are thrown up by monthly rainfall data. Average monthly rainfall made up into a profile over the year shows the cropping season(s). Various indications on agricultural activity are gleaned from the pattern.

(a) Peak rainfall periods are paralleled by peak agricultural activities.
(b) The timing of the land preparation, weeding and harvesting sequence can often be seen from the profile.
(c) Long dry periods indicate when food supply problems are likely to arise for both people and animals.
(d) Short dry seasons, particularly in bimodal rainfall distributions where two crops are taken, indicate management problems in removing one crop and preparing for the next.

Where monthly rainfall data is available for a 25- or 30-year period a crude probability analysis reveals farmer management problems. Monthly data is ranked highest to lowest for each month and divided into five groups with an equal number of years in each group. The boundaries of these groups give crude probabilities of monthly rainfall in eight, six, four and two years out of ten. An example follows.

(a) Ranking of January rainfall

Number of years	5	6	5	5	5
Rainfall (mm)	(220–157)	(151–82)	(75–56)	(55–31)	(21–5)

(b) Probabilities of rainfall in January
Less than about 155 mm = 0·6 or 8 years in 10
Less than about 80 mm = 0·6 or 6 years in 10
Less than about 55 mm = 0·4 or 4 years in 10
Less than about 20 mm = 0·2 or 2 years in 10

A full range of such probabilities shows how risky it is either to plant a crop in November hoping it will flower in January rainfall, or to plant a crop in January hoping for it to mature on the rainfall in the February to May period. Such clues not only focus investigation on farmers' management practices to deal with this level of risk, they also indicate a need for careful thought on maturity periods for introduced varieties once the farmers' way of dealing with such risks is described.

Various strategies may help to offset the risks exemplified by the January analysis:

(a) Late planting of a shorter term variety in February.
(b) Planting of a longer term variety in November with a short-term variety available to plant in February should the January uncertainty heavily reduce its yield.
(c) Planting of a relatively drought resistant crop in November--although perhaps not preferred—and a preferred short-term crop after January.

Examination of market and price data and other information on natural conditions builds up a picture of the production environment faced by local farmers and the parts of that environment which create management problems.

Rapid description and appraisal of the farming system

Taking some twenty professional mandays, this Exploratory Survey involves both the Farm Systems Economist and biologists talking to target group farmers.

(a) Describing farmers' circumstances and the system they follow.
(b) Understanding why they farm in the way they do—their priorities and the constraint on satisfying these.
(c) Reviewing possible technical improvements seen as relevant to farmers' problems and circumstances.

This Exploratory Survey is a pivotal procedure in the sequence of methods for understanding small farmers. Detailed guidelines are used to focus unstructured interviews with farmers from the target group. A set of guidelines for an investigation into present and possible management of the maize crop accompany this paper as an Appendix. Such guidelines may be pre-focused on to a particular problem such as ox mechanisation, dry season feeding of animals, or increased protein production. The content is narrowed by the evaluation of local circumstances preceding the Exploratory Survey.

The Exploratory Survey proceeds by discussion with farmers from the target population over a period of up to ten days. The zoning exercise has distinguished target populations, some of them based on hierarchical divisions within the same geographical area. Certain characteristics pertain to each target population and these form a basis for screening farmers to be interviewed in the Exploratory Survey as representative of the population under investigation. The discussions are a recursive learning process. The guidelines are divided into major sections designed to be 'bite size chunks' both for researchers and for farmers. These sections move from description to evaluation and each section forms the basis for detailed discussion with a farmer on that aspect alone. Some farmers will be sufficiently interested to discuss several sections, others will have had enough after one section. The researchers make field notes. At the end of the day, after talking to perhaps three farmers on various sections of the guidelines, these field notes are rewritten, compared and filled out as an aid to absorbing and evaluating the material obtained. Further farmers will be interviewed on the same sections. Once the researchers feel confident about these aspects of the local farming system summarised in a section they make detailed notes against each head of the guidelines section. Gaps in the information are identified to be filled by further interviews. If a team of researchers is involved a detailed exchange of experience on specific guideline sections, at intervals over the field period, greatly enhances the understanding.

Wherever possible interviews should be carried out in farmers' fields with the visible evidence in front of the discussants. Interviewers should move across the zone, making an initial check on key aspects of the guidelines on starting discussions with a new farmer.

This check verifies the consistency of the farming situation across the area. It also verifies that the respondent is within the target population. Assuming the typical farmer will be prepared to discuss two sections of the guidelines and three farmers are interviewed each day, eight days in the field allows the opinions of four or five farmers to be heard on each section.

In addition to field notes following the same format as the guidelines, towards the end of the field period the researchers prepare a 'scenario' of the local farming system. It emphasises trends in the system and the reasons for the choice of products and management practices. The scenario forms a basis for hypothesis formulation on causatives in the system, to be tested in the final stage of the investigation, and is a first attempt to reflect an understanding of the system and the way it bears on the problem under investigation. This interpretative stage is the centre of the methodology and is an amalgam of description, understanding and experience.

The Verification Survey

The Exploratory Survey uses almost an anthropological approach to understanding the local farming system. It is followed up by a formal survey aimed at verifying that the picture obtained from discussions with a group of farmers is indeed valid for the target population as a whole. The formal survey verifies the descriptive features of the system, the priorities and preferences of local farmers and their problems in terms of resource constraints and the importance attributed to hazards faced. In addition to verifying the picture of the farming system, the survey has three other objectives:

(a) To test hypotheses on the importance of observed priorities, resource constraints and hazards in dictating management strategies and production techniques.
(b) To examine farmers in the population who have succeeded in relieving resource constraints or offsetting hazards by modifying their strategies and techniques.
(c) To test farmers' attitudes to changes in management strategies and production techniques which are hypothesised as solutions to problems or opportunities for farm development.

Verification and hypothesis testing is done by a single visit survey covering some sixty farmers in the identified target population. A questionnaire is developed from the interpretation of the Exploratory Survey results which will take some $1\frac{1}{2}$ to 2 h to complete on each farm. Important parameters may be estimated or measured if the

feasible collection technique is consistent with a single visit and a relatively short period on the farm. Each enumerator will cover two farms a day and the field survey is normally completed within a ten-day period.

In designing relevant adaptive experiments a vital thread running through this sequence of procedures is the interdisciplinary interaction between biological and social scientists. The biologist brings to the process a perception of the likely ideal technical management for crops under the conditions of climate and soil in which the target group of farmers is operating. It is based on accumulated knowledge from previous research either locally or in similar conditions elsewhere. The Farming Systems Economist brings to the process an understanding of farmers' priorities and the constraints operating on him which limit the ways in which he can modify his management. Brought together in the sequence the interaction between the disciplines identifies new techniques which the biologist believes will increase output and which, at the same time, the economist believes are compatible with farmers' priorities and circumstances. The interaction occurs at several places in the sequence.

(1) The biologist evaluates the background information on natural conditions to assess crop potential and management factors likely to be important. The economist evaluates background information on economic and institutional conditions.
(2) In the Exploratory Survey the biologist looks at farmer management practices, evaluating ideal changes required to realise biological potential. The economist understands *why* the farmer is doing things the way he is at present. In interpreting the survey work and hypothesising on possible solutions, the two interact; the biologist puts forward ideal changes in management and improvements in yield likely to result. The economist assesses their possible profitability and compatibility with farmers' priorities.
(3) The biologist helps formulate questions for the Verification Survey, particularly on present management practices to be confirmed, and on proposed management improvements.
(4) The biologist and economist interact to decide experimental variables, treatment levels and levels of non-experimental variables.
(5) The biologist and economist interact with farmers in evaluating the experimental treatments for compatibility with farmers' priorities and work methods whilst the experiments are in the ground.
(6) The biologist and economist interact in interpreting the results of the experiments.

Relevant *experimental variables* are born out of the interaction during the Exploratory Survey (2), as are *treatment levels* compatible with farmers' circumstances. Farmer practices as the logical basis for check treatments, and for the management of the non-experimental variables, are detailed and confirmed in the Verification Survey.

The following example of an interactive sequence is centred on the time of planting of maize, a common component in farmer recommendations and a common variable in maize experiments.

Examining rainfall data for the area of the target group of farmers, the biologist observes a unimodal rainfall profile with no marked periods of uncertainty. The profile indicates that a 180-day variety of maize, planted at the beginning of the rains, would offer the maximum biological potential for the area. In the course of the Exploratory Survey the biologist observes that farmers are planting their maize over a period two to six weeks after the start of the rains. In the same Exploratory Survey the Farming Systems Economist gains an understanding of the reasons for delays in planting. In designing adaptive experiments on maize relevant to target group farmers the two sides of the picture are brought together:

(1) *The Biologist's Contribution*
Early planting is important for optimal yields from a 180-day maize variety which will fully exploit the rainfall profile for the area. Farmers are planting an average of four weeks after the start of the rains and this offers a major opportunity for yield improvement for early planting of a higher potential variety.

(2) *The Economist's Contribution*
The soil is hard and farmers, working with hand hoes, must wait for the first rains to soften the ground before they start cultivation. Hand cultivation is slow and the average local family labour force takes two to three working weeks to prepare and plant a hectare. There is no local labour for hire at this time and tractors cannot work economically in the area. There is no immediate prospect of farmers being able to prepare maize seedbed before the rains to ensure planting immediately after the rains.

(3) *Joint Decision*
In the immediate future farmers are locked into their present maize planting date. Time of planting is not an appropriate experimental variable.

(4) *Consequences for Experimentation*
To be relevant to target group farmers' circumstances, adaptive experiments on maize should be planted one month after the start of the rains. A 150-day variety is most appropriate for these farmers and viable levels of fertiliser use are likely to be influenced by both the variety potential and the delayed time of planting.

Similar interactions evaluate all other management components for maize, focusing adaptive experimentation on those components with both biological potential *and* economic relevance.

This interaction process is crucial in modifying the perspective of biological potential in planning experiments to one which is consistent with farmers' decision criteria.

These, then, are four facets of a low cost approach to understanding small farmers by understanding their farming systems. Our hope is that, by focusing adaptive agricultural research in this way, not only is the resulting technology immediately relevant to a known small farmer population, but also a good deal of extraneous research effort is avoided and scarce research manpower is more effectively utilised. This same set of procedures may also be used for reviewing existing new technology on which it is proposed to base a development project, for assessing its relevance, and for evaluating the feasibility of introducing a new crop or machine to an area in terms of their compatibility with farmers' priorities and existing resource allocations to meet these.

The Verification Survey represents the major commitment of professional time and funds in the sequence. So far this formal sampling of the population has always verified the findings of the pre-survey. There have been no major contradictions. It may be that even this low cost, single visit formal survey is superfluous so long as the Exploratory Survey is rigorous. At present the numbers which this formal survey provides are the only hard evidence produced by the diagnostic process. This is extremely important in convincing 'the Establishment' that there is a need for an understanding of small farmers as a prerequisite to *relevant* research and development efforts.

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APPENDIX: DETAILED GUIDELINES FOR PRE-SURVEY SEQUENCE: BY DISCUSSION WITH FARMERS

I. *DESCRIPTION OF THE LOCAL FARMING SYSTEM*

(1) *Enterprise Pattern and End Uses:*

(a) List the crops grown and livestock kept by local farmers. Note for each one whether it is grown by the majority or only a few local farmers. If a few only, what is special about those few?—Large with plenty of land and capital, close to specialised markets or processing facilities, old and traditional, etc.

(b) For each major crop list the varieties grown, give the local name and, where possible, relate to known variety names. Assess whether each variety is important to most farmers, to a few, or to all on particular occasions. Detail why it is important.

(c) For all major crops, varieties and animals, list the *end* uses to which they are put. This should include the fruit in the case of crops and any other part of the plant used as a product. Animal products and by-products are equally important. Where different varieties of the same crop may be grown by the same farmer it is particularly important that differences in end uses are described.

(d) For each identified product, including varieties with different end uses, detail the sequence which is followed when it is taken from the plant in the field or from the animal. Include *when* it is taken in the life cycle of the plant, how it is prepared or processed or used and, if sold, the exact us it is then put to. In describing these end uses it is important to be detailed right through the sequence.

(e) Note particularly any crops, crop varieties or animals:
  (i) That used to be widespread among farmers of the area but are now disappearing. Assess why such crops, varieties or animals are disappearing.
  (ii) That have recently become popular with the farmers of the area and appear to be spreading. Assess the reason for their popularity.

(2) *Food Supply and Preferences:*

(a) Detail the main dishes eaten by farm families in the area, the constituents of the dishes and the preferred *state* of each constituent. What alternative constituents are used when preferred ones are not available?

(b) List the preferred starch staples and relishes, and the substitute staples and relishes used when preferred ones are scarce. Indicate on a chart:
  (i) the months when each is readily available from farm production
  (ii) the months when supplies may be uncertain
  (iii) the months when supplies are definitely not available from farm production

(c) Assess whether any new foods are becoming popular and replacing traditional ones.

(d) List foods commonly purchased by farm families:
  (i) All the year round.
  (ii) At certain periods of the year which should be specified.

(e) If major foods are bought at certain periods assess whether:
  (i) Most farm families buy some major foods at particular periods in some years.

(f) If families have to resort to buying only in some years assess how frequently this is and the reasons for this problem arising in those years.

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(g) See whether prices of the major foods vary over the year. Give an indication of price levels at seasons when food is: (i) plentiful or (ii) scarce.
(h) Which is the most difficult period of the year for feeding livestock and why?

(3) *Cropping Calendar*

For each crop, and where different varieties are grown by the farming community, for each variety, indicate:

(a) The usual planting time for the crop.
(b) The range in possible planting times, including the latest time that farmers will consider it worth while to plant that crop or variety.
(c) The length of time the crop spends in the ground.
(d) The usual harvest time for that crop.

Also assess the major reasons for farmers planting each crop variety at the time they do.

(4) *Cash Sources and Uses*

(a) List the major crops and livestock products sold by farmers in the area and the main channels through which each is sold.
(b) Assess whether prices earned through the major outlets are subject to large variations (i) between seasons or (ii) within seasons.
Seek to identify reasons for large variations, examples of the extent of variations and, for within-season variations, the periods of high and low prices.
(c) Assess the 'usual' level of cash incomes from the major products sold on local farms.
(d) For products that are foods, as well as sources of cash, evaluate the different circumstances in which farmers will decide to sell rather than store for food. Assess which circumstances are most common in sales decisions.
(e) Assess how common is off-farm employment among farmers and farmers' families. The main types of off-farm employment and the usual level of cash income earned from these sources. Distinguish temporary and permanent off-farm work. For temporary work identify the periods of the year when it is undertaken. Evaluate whether this is because opportunities arise then, or farmers' need cash at these times.
(f) Assess farmers. main cash expenditures during the year and when these arise.
(g) List the purchased inputs recommended to farmers in the area; assess how farmers know of them and what proportion use them. When are the major inputs purchased during the year? Assess whether the farmer has cash at this time.

(h) How much does the typical local farmer spend on purchased inputs in a year?

(5) *Husbandry*

Detail the husbandry practices which most farmers follow for their maize crop. It is important that the description is as detailed as possible.

(a) How does the farmer decide *where* he will plant his next maize crop? What factors does he consider in the decision?

(b) Land preparation:
  (i) What is the method of land preparation?
  (ii) When, in relation to the start of the rains and to planting time, does the preparation start?
  (iii) What sequence of work is involved if there is more than one operation?
  (iv) How does the farmer work; does he prepare a whole field before planting, or prepare and plant a bit the same day, or what?
  (v) What is the final form of seedbed?
  (vi) Are there alternative methods of land preparation?

(c) Planting:
  (i) What is the arrangement of plants in the field, maize and mixtures?
  (ii) Where other crops are mixed in it will be important to describe in what sequence all the crops are put in the ground.
  (iii) How do farmers plant in relation to rainfall; dry planting before rain, the same day as rain falls, within a limited period after rains?
  (iv) Do farmers just make one planting of maize each season or are there usually several?
  (v) Do farmers commonly have to replant or in fill fields?
  (vi) What is the method of putting the seed in the ground, and how many seeds are put in each hole?

(d) Weeding and thinning:
  (i) What implement or implements are used for weeding and what pattern of work is followed between the plants in the ground?
  (ii) How soon after planting is the first weeding done? Does the timing vary very much with conditions; if so, how much and which conditions?
  (iii) How many weedings will normally be done? Will this vary with the date of planting, the weather or the soil in the field selected?
  (iv) Do they thin the maize plants either in the row or from each planting hole. If so, at what age? Do they use the thinnings for cattle feed?

(e) Pest control:
  (i) Major pests for which control is sought.

(ii) Timing and method of control.

Assessment of proportion of local farmers using pest control.

(f) Use of fertiliser on maize (if any)
  (i) Type of fertiliser, source.
  (ii) Usual rate, method and time of application.

Assessment of proportion of local farmers using fertiliser.

(g) Use of leaves, tops and stalks for cattle feeding.
  (i) Proportion of local farmers using.
  (ii) Method of feeding to animals.
  (iii) For leaves; number of pickings made, number of leaves taken and the timing in relation to plant growth.
  (iv) For tops; stage of plant growth at which the top is taken. Is this a critical time for cattle feed?

(h) Method of timing of harvesting and storing.
  (i) At what stage does harvesting begin?
  (ii) What method is followed in picking cobs, dehusking, shelling and disposing of stover?
  (ii) How is the crop stored? Is any preservative used?

(i) Seed selection and preservation
  (i) Do the farmers usually select seed in the field or from their stored harvest? If from store, when is it selected?
  (ii) What criteria do local farmers use when they choose next year's seed from their own crop?
  (iii) Do they process and preserve the chosen seed in a special way?

Is the crop treated in any other way, either while in the field or in the household?

II. *IDENTIFICATION OF RESOURCE CONSTRAINTS*

(1) *Land:*

(a) Are farms in the area registered or held under traditional custom?

(b) What proportion of the area of land held by the typical local farmer is cultivated in any one season and what proportion is under grass or fallow?

(c) Is the arable area changed periodically and allowed to fallow?

(d) Are crops rotated? If so, what crop sequences are followed?

(e) Can farmers get new land; by clearing, by renting, by purchase? If so, how far away would new land for clearing be? How much money would be needed to rent or purchase an acre? Would this vary by the type of soil and location of the piece of land?

(f) Soil types and maize management
  (i) Do farmers prefer a specific type of soil for growing maize? If so, which and why?

(ii) Do farmers prefer a special location for their maize crop?
(iii) Do farmers vary the soil type and/or location where they grow their maize depending on the sort of season they expect. If so, what influences their decisions?

(2) *Labour:*
(a) What is the busiest month of the year for local farmers? During this month what work are they doing mainly and with which crops?
(b) Is this the busiest month every year, or does it vary from year to year?
(c) Which is the second busiest time of the year for local farmers and what work are they doing then and on which crops?
(d) Do many local farmers hire any labour:
(i) Permanently throughout the year?
(ii) Temporarily for a particular job or particular period?
(iii) When farmers hire casual labour what month or months is it mainly hired and for what type of work?
(e) Do many farmers hire machinery? If so, is it tractor or ox driven? Which operations is it mainly hired for? At which time of the year and for which crops?
(f) How much money will a typical farmer spend on hired labour and machinery in a year—if any?

III. *FARMERS' ASSESSMENT OF HAZARDS*

(1) *Yield Variability:*
(a) What variation do farmers expect in maize production from season to season:
(i) What sort of production would they expect in a 'bad' year?
(ii) How frequently do such bad years occur in the area?
(iii) What are the main factors that make a year bad for maize?
(iv) What sort of production would they expect in a 'good' year?
Repeat for the three or four major crops in the system.
(b) As far as the farmers are concerned, low yields in which crop are the most serious for them and their families?
(c) What measures do they take to combat the effects of low yields when they occur—how do they manage when production of this vital crop fails?

(2) *Rainfall Problems:*
(a) Which crops sometimes give poor results because of rainfall?
(b) With reference to maize, which type of rainfall problem is most serious?
(i) Late start to the rains.
(ii) Too little rain during the growing season.

(iii) Early finish to the rains.
(iv) Too much rain.

(c) When did this type of rainfall problem occur on a widespread basis in the area and give a poor maize crop?

(d) Discuss with farmers how they react to this type of failure; i.e. they know their next maize harvest will be poor:
(i) In preserving food supplies in the household.
(ii) In managing their farms to offset the effect on their food supplies.

It may be important to go through this sequence with reference to another major starch staple—sorghum, where grown—and a major relish crop.

(3) *Pests and Diseases*

(a) What do local farmers consider as their major pest and disease problems? Specify: (i) Crops and pests. (ii) Frequency with which the problems occur.

(b) Do local farmers believe they have any means of managing their farms to *prevent* these pests and diseases occurring? Discuss them one by one.

(c) Do local farmers have any way to treat the crops or the land once they see these pests and diseases appearing? Discuss them one by one.

IV. *FARMERS' OPINIONS ON COMPONENTS OF CURRENTLY RECOMMENDED MAIZE TECHNOLOGY*

From the Ministry of Agriculture write out, in full, the current recommendations for growing maize in the area. Taking one component of the improved management at a time, discuss it with local farmers. Attempt to assess the problems which each component presents to them in their situation.