Diagnosis of Farmers' Conditions

Farmer participatory research involves more than identifying research participants, of course. It also involves identifying "users" or "clients." These are the farmers whom researchers wish to reach with technologies and practices, and they are not necessarily participants in the research (either informants or experimenters).

Scientists may think that "all farmers are the same" or that they are working with "typical" or "representative" farmers, but unless researchers systematically address this issue from the start, they may be making a critical mistake. As discussed earlier, farmers and their households often are not homogeneous, even within a community. Farming households in a community have access to different resources. Some have more land, labor, or capital than others. Knowledge and information are not shared equally, either. Therefore, goals, resources, and constraints differ between farming households. Variability—spatial and temporal—is another fact of life for every farmer and his/her household. Soils and topography vary and seasons change. Because this variability influences what farmers can and wish to do, it is fundamental that researchers understand how resources and constraints are distributed in time and space.

In failing to recognize differences between farmers and households, researchers may overestimate the potential impact of technologies or practices, because researchers may end up working with a smaller and possibly unrepresentative subset of the farmers they hope to serve, or they may have a very static view of farmers' resources and/or constraints. In other words, researchers run the risk of developing technologies that are adopted by a more restricted number of farmers than expected or desired, resulting in a lower impact than anticipated. It is crucial to identify and characterize groups of farmers who share similar goals, resources, and constraints in their socioeconomic and the biophysical environment, because these farmers will share similar problems and require comparable solutions (technologies/practices).

Many methods have been developed to describe and analyze socioeconomic and biophysical variability, but in a participatory approach our goal is to discover how the farmer and his/her household view this variability. Methods for achieving this goal for the socioeconomic environment include farmers' own classification of farmers, wealth ranking, a minimum set of socioeconomic indicators, and a calendar of activities. Methods for understanding farmers' view of variability in the biophysical environment include local classifications of soils and climate. Each of these methods is described in the sections that follow.

Local Classification of Farmers

Goal: Identify the socioeconomic categories and characteristics that farmers find relevant.

Rationale: Farmers have their own categories for classifying themselves. By eliciting these categories and their strengths and weaknesses, researchers should be able understand what is important about these farmers in an open but systematic way, without imposing their own views on the farmers. This information can be used to generate hypotheses about how farmers' conditions and technologies interact, identify factors that affect technology adoption, and define groups facing similar conditions regarding technological needs or constraints (e.g., recommendation domains).

Method: Researchers assemble a group of informants from a community, ideally a mixture of people of different ages, resources, and genders. The interviewer explains the objective of the exercise to the participants: researchers want to gain a better understanding of which types of farmer exist in their community, including the strengths and weaknesses of each type. The interviewer should also explain that this information will help researchers to understand farmers' problems, develop possible solutions, and guide them, as scientists, to interact better with farmers.

The interviewer poses the question: *What types of farmers are present in your community?*

The group makes a list of each of the types.

For each type, the interviewer asks the following questions:

What are the characteristics of this type of farmer? (In some cases these are obvious from the name of the category, but in others they may have to be described in greater detail.)

What are the strengths of this type of farmer? (In many cases, strengths can be interpreted as the resources available.)

What are the weaknesses of this type of farmer? (In many cases, weaknesses can be interpreted as the constraints faced.)

Table 2 shows the types of data that can be gathered using this method. It is important to identify responses that refer to the same concept, since people may express their ideas in different forms. This requires some judgement on the part of the scientist, but usually it is not difficult. The farmer types usually refer to the presence, absence, or extent of an attribute, such as the ownership or lack of an asset (e.g., owns cattle, does not own cattle, owns a few cattle but not a lot). The number of types can be very large, and some of them are likely to be correlated. For example, one type may be "farmers with cattle" and another "farmers with manure." Clearly, farmers who have cattle are also likely to have manure.

Implicit in the farmer types are "themes" or wider categories, which make it possible to group different types within a larger theme or category. These themes or categories become the basis for analyzing the classification. They tell researchers which factors farmers consider important and in many cases how the factors are related. These factors and their relationships can be used to group farmers in homogeneous groups and/or to generate hypotheses about how these factors influence farmers' decision-making (see example).

Table 2. Data collected in an exercise to elicit farmers' classification of themselves, Chihota, Zimbabwe

Farmer type	Strengths	Weaknesses
Farmers who plan	Farm operations done on time Good crop stands	Crops can be eaten by livestock Crops wilt if rains come late
Farmers who do not plan	–	Extensive farmers No rotations Lack resources
Farmers with cattle	Have manure Have resources	Do not have grazing areas
Farmers without cattle	Borrow in time Provide labor for others	Delayed farming operations Lack resources, lazy at times
Farmers with manure	Crop stands are good and yields high	–
Farmers without manure	–	Crops are of poor quality and therefore yields are low
Field farmers	Plan well ahead of time High volume of output for storage	Seasonal farmer Take risks because production is seasonal
Garden farmers	Stable income because production is perennial	Do not help the needy
Resource-rich farmers	Sell produce to others Stable income Farm operations done on time	Do not give implements for free

Source: Gambara et al. (1998).

Example: This method was used in the diagnosis component of the Chihota Project to assess and understand the heterogeneity of farming households and to identify some of the socioeconomic variables underlying this heterogeneity. Agritex extension officers organized focus group discussions with farmers working closely with them. There were three types of groups: male, female, and mixed, for a total of ten groups.

The groups identified 29 farmer types. This number may seem excessive and the types *ad hoc*, but analysis of the types revealed that they could be grouped into eight themes or categories. (The data in Table 2 came out of that exercise.) Table 3 shows the types grouped by category. Some of the types refer to personal characteristics such as age and sex. Most involve the ownership or lack of an asset such as cattle, or access to income or knowledge. The themes or categories refer to common socioeconomic variables such as age, gender, wealth, and access to inputs and knowledge. Although many of the results presented below may seem obvious, the reader should bear in mind that there was no *a priori* reason why this should have been so, and that this information was collected in only four days of fieldwork. For somebody not familiar with the system, this information may be very valuable to provide a first set of hypotheses about the socioeconomic factors that are important. At least it can serve as a check that farmers also attach importance to factors that scientists believe are important.

Based on the strengths and weaknesses[4] associated with each farmer type, the following picture emerged from Chihota

[4] Presented at length in Appendix 1. This appendix provides a good sense of the "raw" data collected in this type of exercise.

farmers: Age is a category associated with the ownership of assets, access to family labor, and knowledge. In general, younger farmers are considered worse off than older farmers. Gender is associated with control over labor, assets, and income. Male farmers are in control. Not surprisingly, there seems to be tension between male and female farmers. For example, females consider that they are not rewarded for their labor and that their fields are prepared last.

Table 3. Farmers' classification of themselves and their characteristics, Chihota, Zimbabwe

Socioeconomic category	Farmer type	Number of groups mentioning type
Age	Young	3
	Old	3
Gender	Male	3
	Female	3
Ownership of, access to inputs	Draft animals	3
	Cattle	3
	Manure	1
	Implements	4
	Garden	6
	Dry lands	6
	Large fields	1
	Small fields	1
	Own fields	1
	Fenced fields	1
Labor allocation	Works outside the area	1
	Works in groups	2
	Works individually	2
	Industrious	4
	Lazy	4
Access to cash, wealth	Adequate cash for farming	3
	Rich	2
	Poor	2
Knowledge	Has knowledge	5
	Has Master Farmer Certificate	1
Linkage to market	Sells produce	1
	Farms for subsistence	1
Synthetic (combines different categories)	Performs operations on time	2
	Attains high yields	1
	Plans operations	1

Source: Bellon et al. (1999).

The ownership of assets in general is linked with the timing of farming operations, the ease of performing them, and the crop yield achieved. Owners are considered to perform operations on time and easily, and therefore to get higher yields than non-owners. A particularly important asset is the ownership of gardens. Gardens were mentioned in very positive terms. They provide a stable income and are less subject to drought compared to dry lands, where income is more seasonal, less stable, and production is more exposed to drought. The size of landholding is another interesting case. Farmers consider that farmers owning larger fields tend to spread inputs thinly, while those with smaller fields concentrate inputs. Cultivating as large an area as possible is a practice that has been observed in marginal environments in Africa, and it may be a risk management strategy or a means to establish or maintain property rights over the land.

Labor allocation refers to a process by which farmers with skills to work elsewhere substitute hired local labor for their own labor, which highlights the increased integration of these farmers into the market economy. Another aspect of labor is organized labor; farmers working in a group cooperate by sharing labor as well as knowledge, and they can buy inputs together. Working in a group may be more common among farmers who work closely with extension, since extension staff often favor group arrangements.

A puzzling classification is the one that identifies farmers as "lazy" or "industrious." It is not clear whether "lazy" farmers are truly lazy or if they are classified this way because they are

poor or sick. For example, participants recognized that "lazy" farmers were a good source of labor for others, which raises the question of why these farmers are working for others, if they are so lazy. Puzzling results such as this may be the product of rapid research, and a longer stay and interaction with farmers may reveal the factors that explain the puzzle. At least two hypotheses about these types of farmers can be considered. One is that there are lazy people in any society, and these farmers are indeed lazy; the second is that the farmers participating in the group classification exercise are of a higher social status and consider people of lower status to be lazy, even if clearly they are not, since they work for them.

Access to cash is linked with the timing of farm operations and with the ability to purchase inputs and hire labor. Those with access to cash were considered to be in a better position that those without it.

Farmers who possess knowledge are viewed very positively. The groups provided a long list of strengths for those who have knowledge and a long list of weaknesses for those who do not. Knowledge is associated with timely operations, high yields, and crop rotations. The emphasis on knowledge may also be related to the fact that almost all participants work with the extension service. Therefore they value access to knowledge and have been exposed to the message that knowledge is important.

Linkage to the market captures the differences between those who sell their produce and those who are subsistence farmers. This distinction may not be absolute, since it is most likely that many farmers produce crops for sale as well as subsistence.

Finally, three types appear again and again, frequently together, as attributes throughout the farmer classification: timely performance of farming operations, high yield of crops, and planning of operations. These attributes are highly correlated. As farmers see it, the ownership of assets, access to cash, and possession of knowledge lead to good planning and timely operations, which in turn lead to high yields.

The classification provides researchers with a set of variables that can be used to group farmers in homogeneous groups: by age, gender, ownership of assets, labor allocation strategy, and access to knowledge. For example, the most contrasting groups can be seen as 1) young females with few assets, who do not work off of the farm and have poor access to knowledge, and 2) older males with many assets, who work off of the farm and have good access to knowledge. Obviously these groups may have different goals and resources, face distinct constraints, and require different technologies.

The classification also provides researchers with a set of hypotheses about the problems that these farmers face and their possible causes. It should be pointed out, however, that in many cases these classifications provide researchers with *associations* between factors and not necessarily with *relations of causality*, which researchers have to deduce. For example, the following hypotheses derived from the example can be postulated:

- Female farmers get low yields because their fields are plowed late by male farmers who control the oxen and the implements.
- Male farmers who own oxen get higher yields because they perform operations on time.

- Farmers who own cattle get higher yields because they have access to manure to apply to their crops.
- Farmers working in groups get higher yields because they gain better access to inputs by pooling their resources.

These hypotheses can be expressed in a causal diagram that provides a model of how different factors interact (Figure 3). This figure illustrates the relationship between factors identified in the classification, particularly in relationship with the timing of the performance of agricultural operations and yields.

Comments: The types elicited from farmers may, in some cases, be self-serving and value-laden. For example, it is not clear whether the qualities of laziness and industriousness refer to truly personal characteristics, describe a position within a social hierarchy, or represent a value judgment by one group of people regarding others. In interpreting the data, researchers should always be careful to recognize the implicit value judgments and the social relations present in these types.

Another example of how informants' judgments can be value-laden or self-serving comes from the list of strengths associated with farmers who have no cattle (Appendix 1). According to informants, those farmers have the following strengths: they borrow money, provide labor for others, are cattle herders, and buy cattle from others. Clearly, these qualities are viewed as strengths by those who benefit from farmers without cattle: people who lend them money, hire their labor, or sell animals to them (e.g., cattle owners). Furthermore, an examination of the weaknesses listed for farmers who have no cattle (such as cruelty to cattle or gaining when crops are unintentionally destroyed by livestock) confirms that these views come from people who have cattle.

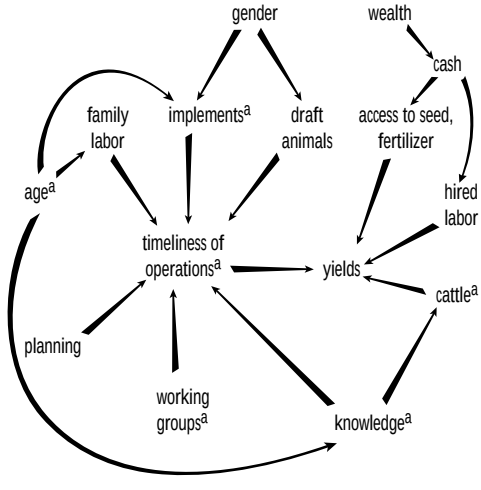

Figure 3. Causal diagram of the factors that affect yields based on those identified by farmers' classification of themselves in Chihota, Zimbabwe.

[a] Indicates a factor associated with a farmer type; the rest indicate factors identified as strengths or weaknesses associated with a farmer type.

Wealth Ranking

Goal: Classify farmers in a community into wealth categories.

Rationale: Wealth is an important social category in most societies, although its specific definition will vary not only from one culture to another but sometimes from one village to the next. Wealth is a relative category that depends on the very particular circumstances of farmers. Unlike the local classification of farmers discussed previously, wealth ranking establishes certain predetermined concepts and categories (e.g., "wealth," "rich," "poor"). The specific definitions of "wealth" and of what constitutes a "rich" or a "poor" farmer depend on the local conceptions of these terms. Members of a community usually are keenly aware of their positions and those of others in the community. This method is based on that knowledge. The

wealth ranking provides a way to group farmers and analyze their preferences. Clearly what is appropriate or desirable for one wealth group may not be so for another. Furthermore, the constraints to adopting a new technology or practice may be completely different among wealth categories, since each may control different sets and amounts of resources. A wealth ranking is also a tool to analyze the potential and actual distribution of benefits and costs of a technology (see "Comparing Different Technological Options," p. 54, for an example of how wealth ranking can be used).

Method:[5] This method assumes that researchers have compiled a list of households in a well-defined community/village, which they want to rank. The researchers will need to define what constitutes a household in the particular place where they are working. Although a household is often defined as a group of people who live together and eat from the same pot, this definition may not be useful in certain societies with extended families, and researchers should establish what constitutes a household through discussions with local informants. A few (one to four) reliable informants with good knowledge of the people in their community should be identified. It may be a good idea to include male and female informants. Informants can be interviewed either together or separately. The former strategy provides a consensus ranking, while the latter makes it possible to test the consistency of the rankings. In the case of multiple individual rankings, the rankings of several informants should be highly correlated. If they are not, the lack of correlation indicates that there is a problem. Perhaps the informants do not know the households well, have access to different information, have used different criteria to do the ranking, or have simply not provided accurate information.

First, the interviewer asks the informant(s) to define what "wealth" is in the community. After identifying the local word(s) for wealth, the interviewer and informant(s) can discuss what a "wealthy" or rich household/farmer is, focusing particularly on its characteristics. Then the characteristics of poor farmers can be discussed; following that, the characteristics of the group that falls in between (not rich or poor) can be identified. After the distinctive characteristics of each group are defined, the interviewer writes the characteristics corresponding to each group on a large, easily visible piece of paper. The interviewer checks with the informants to see that everyone agrees with the characteristics. Next, the interviewer reads the names of the farmers from the list of households and asks the informants to indicate the group to which they belong. Alternatively, researchers can prepare cards, each one with the name of a household, and ask the informants to put them into one of three piles, each representing a wealth rank.

When this exercise is done with a group of informants rather than an individual,

5 Some of the ideas described here are based on Grandin's (1988) work on wealth ranking, although the method presented here differs somewhat from her approach. In Grandin's method, informants make as many groups as they wish by creating piles of cards containing the names of households that in their view belong in the same wealth rank. Then each household is given a score based on the pile where it was classified, and the scores of several informants are averaged out. This average is used to do the final ranking. For the specifics of the method consult Grandin (1988).

the group may discuss the classification. If there is disagreement about the classification, the interviewer should ask about the reasons for the disagreement and note the contrasting rankings that informants provide for farmers who classification was disputed. When the exercise is done with several individual informants, the researcher should compare the characteristics associated with the rich, intermediate, and poor, as well as the rankings, once the exercise has finished. If discrepancies are identified, ideally the researcher should go back to the informants for clarification, and this information should be noted as well.

If in addition to (and independently of) the wealth ranking the researcher has collected other qualitative and/or quantitative socioeconomic data on the households that have been ranked, the researcher can test for an association between those variables and the wealth ranking. Ideally this association should be significant, as indicated by statistical analyses of the quantitative and qualitative data, using the wealth classes as a grouping factor by village. A significant association provides independent evidence of the validity[6] of the wealth ranking. In most cases, however, such data are not available, which is one reason why a wealth ranking may be done. It should be stressed that a wealth ranking is faster, cheaper, and easier to implement than a full-scale survey.

Even if socioeconomic data are available, it may still be desirable to perform a wealth ranking. The wealth ranking is based on the knowledge of local people who may be aware of assets and relationships that may not even have been captured by survey data. These include initiative, entrepreneurial ability, experience, and social or political relationships.

Example: This methodology was used in the Chiapas Project to rank all the participating households and test the extent to which different types of farmers adopted various maize varieties. The informants defined wealth based on certain characteristics such as ownership of a pair of bullocks, cattle, a motor vehicle, or appliances; the type of house; and total landholdings. Poor households had houses made of wattle and daub or adobe, without cement floors and plastered walls, and possessed almost no appliances. Fewer households owned a pair of bullocks and some cattle. None had privately held land or a motor vehicle. Households that were intermediate between rich and poor had adobe houses with cement floors and plastered, painted walls. Ownership of a television set, gas stove, and even a refrigerator was common. Many households owned a pair of bullocks and cattle, and a few had privately held land. Rich households owned brick or adobe houses with cement floors and plastered, painted walls. These households had television sets, refrigerators, gas stoves, and even videocassette recorders. Some owned a pair of bullocks but others did not, since they had a tractor or could pay to rent one. Many had privately held land and some had motor vehicles.[7]

6 Validity denotes the extent to which a measurement tool is measuring what it was designed to measure (Adams et al. 1997).

7 Contrast this ranking in Chiapas with one in Malawi (Smale and Phiri 1998), where well-to-do households produced enough maize to last from harvest to harvest; owned some livestock, an oxcart or other farm machinery, and several changes of clothing; and had a house with an iron roof and brick walls.

Independently of the wealth ranking, a household survey was done for all households. The survey included questions on socioeconomic variables such as landholding, ownership of livestock and other assets, performance of off-farm labor, and reception of remittances. Therefore the validity of the wealth ranking could be tested. To do so, an analysis of variance (ANOVA) was done to compare the means of each of the wealth classes (rich, intermediate, and poor) for key quantitative socioeconomic variables, and a Chi-square test of association was done to assess the relationship between wealth rank and each qualitative variable. Table 4 presents the results.

The wealth ranking was consistent with objective, independently measured characteristics of the households. In general the trends in ownership among wealth ranks were what one would expect: the rich had more assets than the intermediate class, and the intermediate class had more assets than the poor. These results corroborate the validity of the wealth ranking. Furthermore, the wealth ranking was included in a regression analysis that showed that those classified as poor planted on average a smaller area to improved varieties and a larger one to landraces than the rest (Bellon and Risopoulos 2001). These results show how combining participatory methodologies with more conventional analytical tools can enhance the analysis.

Comments: This method is most appropriate for a single village or community since it relies on the knowledge that the informants have of fellow community members, and the definition of wealth classes is relative to

Table 4. Comparison of farmer characteristics by wealth rank, Chiapas, Mexico

	Wealth rank				
Variable	**Poor**	**Medium**	**Rich**	**Overall**	**P-value[a]**
Number of farmers	50	32	16	98	–
Ownership of assets					
Total land holdings (ha/farmer)	6.2	10.6	14.5	9.0	.000
Cattle (% farmers own)	18.0	37.5	68.8	32.7	.001
Cattle (head/farmer)	1	3	11.2	2.9	.000
Pair of oxen (% farmers own)	44.0	50.0	56.3	48.0	.668
Horses (% farmers own)	58.0	75.0	87.5	68.4	.054
Pigs (% farmers own)	64.0	84.4	75.00	72.5	.127
Pick-up truck (% farmers own)	0.0	3.1	68.8	12.2	na
Tractor (% farmers own)	0.0	0.0	6.3	1.0	na
Sources of income					
Off-farm labor by farmer (% performing)	68.0	43.8	37.5	55.1	.030
Type of labor (% performing)					.009
Agriculture	50.0	42.9	16.7	44.4	–
Construction	29.4	57.1	16.7	35.2	–
Commerce	0.0	0.0	16.7	1.9	–
Other	20.6	0.0	50.0	18.5	–
Off-farm labor by other family members (% performing)	40.0	75.0	37.5	51.0	.004
Remittances (% receiving)	10.0	28.1	18.8	17.4	.106
Use of hired labor (% hiring)	58.0	68.8	93.8	67.4	.029

[a] P-value associated with a Chi-square test of association for qualitative variables and one-way ANOVA for quantitative variables; na = not applicable (too many blank cells).

the members of the community. Comparisons across communities may be more difficult, because the definition of "rich" or "poor" in one place may be different in another. There is good evidence, however, that at least in certain circumstances wealth rankings are valid across regions (Adams et al. 1997). Even if this is not the case, the characteristics that informants use for the classification may provide a rough basis for comparisons across villages. If additional quantitative and/or qualitative socioeconomic information is available, then researchers can compare the wealth classes among villages.

Minimum Set of Socioeconomic Indicators

Goal: Identify key characteristics of participants (informants/experimenters). If possible, compare them to the population of users/clients, and thus establish whether they are representative (or at least make any bias explicit).

Rationale: One problem with participatory work is that usually it involves a self-selected group of people (i.e., the people who choose to participate). This group does not necessarily reflect the conditions and interests of all farmers in a region, so it is important to know the participants. The content and quality of the information elicited and the joint outputs obtained depend on the people with whom researchers work. To assess the degree to which participants are representative of all farmers in the region of interest, the researcher should compare the participants' characteristics with characteristics of the population of households in the region.

Method: Develop a short questionnaire that includes a few, mostly qualitative questions. The questionnaire should be filled in 5 to 10 minutes with all participants in an activity or (if the number is too large) with a sample of them (e.g., one out of four). The questions should be simple and easy to answer. Usually they will deal with characteristics that reflect the participants' resources, constraints, and goals. Ideally, the information gathered should be comparable to other information that is representative of the households in the region of interest, such as a census or a representative survey. The questionnaire may request information on:

- gender;
- age;
- ability to read and/or write;
- number of years of formal education completed;
- number of years of independent farming (farming experience);
- size of land holdings by tenurial arrangement (this requires previous knowledge of the land tenure regime);
- crops grown;
- types and number of animals owned;
- agricultural off-farm labor;
- non-agricultural off-farm labor; and
- remittances from family members working elsewhere.

The researcher may decide to include other key characteristics identified from farmers' own classification. It is important to clarify whether the questions refer to the respondent *as an individual* or to *the household in which he or she lives*. For example, the enumerator should carefully specify whether the question refers to land owned or controlled by the respondent as an individual or to land that is owned or controlled by the respondent's household.

The same specificity is needed when asking about animals and sources of income.

Example: In the Oaxaca Project, field days were organized for farmers to vote on the landraces collected so that they could be sorted into a gradient of interest. During these field days a questionnaire was used to obtain a minimum set of socioeconomic indicators. The purpose of the questionnaire was to get an idea of participants' characteristics and to separate farmers' votes from the votes of the other field day participants. The purpose of the voting exercise was to gauge farmers' interest in the landraces, so researchers were not concerned with the votes of other participants. The questionnaire showed that of 306 persons who attended the field days, only 213 individuals were involved in maize farming, and 54% of these were women. Only the votes of those 213 individuals were taken into account.

The questionnaire also revealed important differences between male and female farmers who participated in the field days (Table 5). Compared to the men, the women were younger, had less farming experience and more formal education, and planted a much smaller area to maize on average. More women received remittances, and fewer worked off of the farm. Not surprisingly—given that women planted a smaller area to maize than men—a higher proportion of women purchased maize and a lower proportion sold it. Almost all of the women said that they grew maize to be self-sufficient in that commodity, compared to a still important, but smaller, percentage of men. The percentages of male and female participants who said that they grew maize

Table 5. Field day participants in Oaxaca, Mexico, characterized by agricultural activity, gender, and other variables

Characteristic	All	Male	Female
Number of participants	213	97	116
Age (yr)	43.6	49.7	38.4
Mother tongue (% speaking)			
Spanish	88.0	87.9	88.0
Zapotec	11.6	12.1	11.1
Other	0.4	0.0	0.9
Education (mode)	Elementary, not completed	No education	Elementary, not completed
Experience in farming (yr)	19.7	24.1	15.9
Area planted to maize (ha)	2.7	4.3	1.3
Remittances (% receiving)	44.0	40.4	47.0
Off-farm labor (% performing)	47.2	57.6	38.5
Purchase maize (%)	55.1	39.4	68.4
Sell maize (%)	28.7	38.4	20.5
Goals of maize production (%)			
Home consumption	94.0	88.9	98.3
Sale	24.1	33.3	16.2
Livestock ownership (%)			
Bullocks	31.5	49.5	16.2
Cattle	31.0	39.4	23.9
Pigs	59.3	48.5	68.4
Poultry	71.8	70.7	72.7
Goats, sheep	38.6	36.7	40.2

Source: Bellon et al. (1998).

for sale differed dramatically. Twice as many men as women engaged in commercial maize production. Another difference between female and male participants was that a higher percentage of men tended to own bullocks and cattle, whereas women tended to own pigs. These data suggest that while self-sufficiency was a fundamental goal of all farmers, men tended to be more commercially oriented, to produce more maize because they planted a larger area, to depend more on off-farm labor and less on remittances, and to raise different types of livestock. These findings, in turn, suggest that men and women may value the characteristics of maize varieties differently.

Aside from the questionnaire for field day participants, researchers surveyed a sample of farmers in the Oaxaca study sites (baseline survey). The random, representative sample of the farming population in the region enabled researchers to determine the extent to which field day participants were representative of the farming population in the area. A few questions asked of field day participants were not included in the sample survey, although the sample survey retained the questions related to personal characteristics, sources of income, and agricultural assets. Table 6 compares some of the personal and household characteristics of participants in field days with

Table 6. Selected personal and household characteristics of participants in field days and sample survey, Oaxaca, Mexico

	Females		Males		Households	
Characteristic	Field days	Sample survey	Field days	Sample survey	Field days	Sample survey
Participants (no.)	116	240	97	240	213	240
Age (yr)	38.3	48.1^{+++}	50.1	54.2^{++}		
Education (% reporting)						
No formal education	8.6	31.3***	5.2	16.7***	–	–
Elementary, not completed	36.2	40.0	38.1	53.8	–	–
Elementary, completed	38.8	22.5	33.0	22.9	–	–
Junior high school	9.5	3.8	10.3	3.8	–	–
High school or technical school	5.2	1.7	3.1	2.1	–	–
College	1.7	0.8	10.3	0.8	–	–
Literacy (%)	92.2	67.9***	94.8	82.1***	–	
Mother tongue Spanish (%)	87.9	74.6***	87.6	68.3***	–	–
Non-farm sources of income (%)						
No off-farm labor or remittances	–	–	–	–	25.4	26.3^{ns}
Off-farm labor only	–	–	–	–	30.5	37.5
Remittances only	–	–	–	–	28.2	24.2
Off-farm labor and remittances	–	–	–	–	16.0	12.1
Maize area (ha)	–	–	–	–	1.8	3.0^{+++}
Ownership (%)						
Pair of bullocks	–	–	–	–	31.5	59.6***
Cattle	–	–	–	–	30.5	37.9*
Pigs	–	–	–	–	59.2	50.0*
Horses, mules	–	–	–	–	45.1	76.7***
Goats, sheep	–	–	–	–	38.0	40.4

Source: Bellon et al. (2000).

Note: ++ (+++) indicate t-test, significant at the .05 (.01) level; * (**) *** indicate chi-square test of homogeneity, significant at the 0.1 (.05) .01 level; ns = not significant. In the case of education and sources of income, the statistical test applies to all categories.

information from the random sample of farmers in the study sites. These data make it possible to test whether there was a bias between field day participants and a representative sample of the population of farmers in the area.

The results show that men and women who participated in the field days were younger and better educated than the average for the region. A higher percentage of field day participants had Spanish as their mother tongue compared to the respondents in the sample survey. In terms of non-farm sources of income, there was no difference between field day participants and respondents in the sample survey, although the survey respondents farmed a larger maize area and a higher percentage of them owned bullocks, cattle, horses, and mules. These data do not necessarily mean that field day participants are poorer than the survey respondents. Since field day participants generally have more years of formal education, farming may have contributed less to their livelihoods than it did for farmers in the region as a whole. Field day participants seem to be a biased sample of the overall farming population of the region, but regardless of the reason for the bias, maize farming is clearly still important for field day participants, as demonstrated by their attendance at the field days.

Ideally the researcher would like a representative sample of farmers to participate in the research activity, but participation is a voluntary endeavor, and farmers cannot be forced to participate purely for "representation."

Comments: One problem with the minimum set of indicators is that if they change from one group to another or from one situation to another, it may be difficult to compare results. As more information becomes available, for example, a researcher may wish to change the indicators to fit the new knowledge, but this should be avoided to the extent possible. If changes are unavoidable, the researcher should at least retain as many common indicators as possible. Ideally, researchers should include questions that elicit information that is comparable to information from other sources, such as census or other survey data, so that results can be compared and if possible extrapolated across different groups or settings.

Calendar of Activities

Goal: Identify how productive and leisure activities are organized and interact during the year in a community.

Rationale: Households in a community, and individuals within them, carry out different activities during the year. These activities may be complementary, may compete with one another, or may not interact at all. Competition in the allocation of time among activities is an important consideration for any household because it has implications for the household economy. It is particularly important to identify any labor bottlenecks and when they occur. Researchers should be especially careful to develop separate calendars for males and females within the same household, because their activities may differ substantially.

Method: The method presented here is to develop a generic calendar of activities for a community. The method focuses on all of the activities carried out by all households within a community, rather than on the activities of one specific household, because an

individual household may pursue only a subset of the activities carried out across a community. Identifying specific combinations of activities for specific households will provide an idea of the different livelihood strategies present in the community.

A group of key informants is assembled and asked to list all activities in which males and females engage. First the group is asked about productive activities, which in the case of agriculture would include crops grown and types of livestock kept. Informants are also asked about the kinds of off-farm labor in which they engage, such as day labor in agriculture, construction work, and working as a mechanic or carpenter. Second, the group is asked to list activities necessary for the household to function, including food preparation, going to the market to purchase food, repairing the house, cleaning the house, and studying with children. Third, the group is asked to list activities conducted for the community, such as repairing the roads or irrigation system or organizing and participating in religious celebrations. Finally, informants are questioned about their leisure activities, including time spent resting.

Once the list has been compiled for each type of activity, informants are asked to point out the months during the year when they take place and to specify which household members participate.

Activities of particular interest may be disaggregated by subactivities. For example, maize production can be disaggregated by land preparation, number of weedings, number of fertilizer applications, harvest, storage, and sale, and informants can identify the month of the year in which each subactivity takes place.

Example: Figure 4 is a one-year calendar of activities for Santa Ana Zegache, a community in the Oaxaca Project. Activities related to crops and animals are listed first, followed by off-farm labor, community work, and religious celebrations. This calendar shows the conflicts between tending one's own crops of maize and beans and performing agricultural labor off of the household farm. Taking care of sheep and goats is a year-long activity, while caring for cattle has a better defined period. To analyze the potential impact (timing conflicts and opportunity cost) of a new activity, such as growing a new crop or building contours for erosion control, the labor demand for the new activity should be overlaid on this calendar.

Comments: One common mistake with this method is that researchers develop a calendar only for agricultural activities, ignoring off-farm labor, community work, and religious celebrations. Such a calendar may omit activities that are as important—or even more important—than the agricultural ones.

One limitation of this method is that it provides information only on the timing of activities and not on the intensity of labor use. The researcher knows when an activity takes place but not how much time and labor it requires (information that can be difficult and time consuming to obtain).

Local Taxonomies of Soils

Goal: Identify the soil types farmers recognize and the characteristics they find relevant for each type.

Rationale: Farmers have their own categories for classifying soils. They may recognize different problems in each

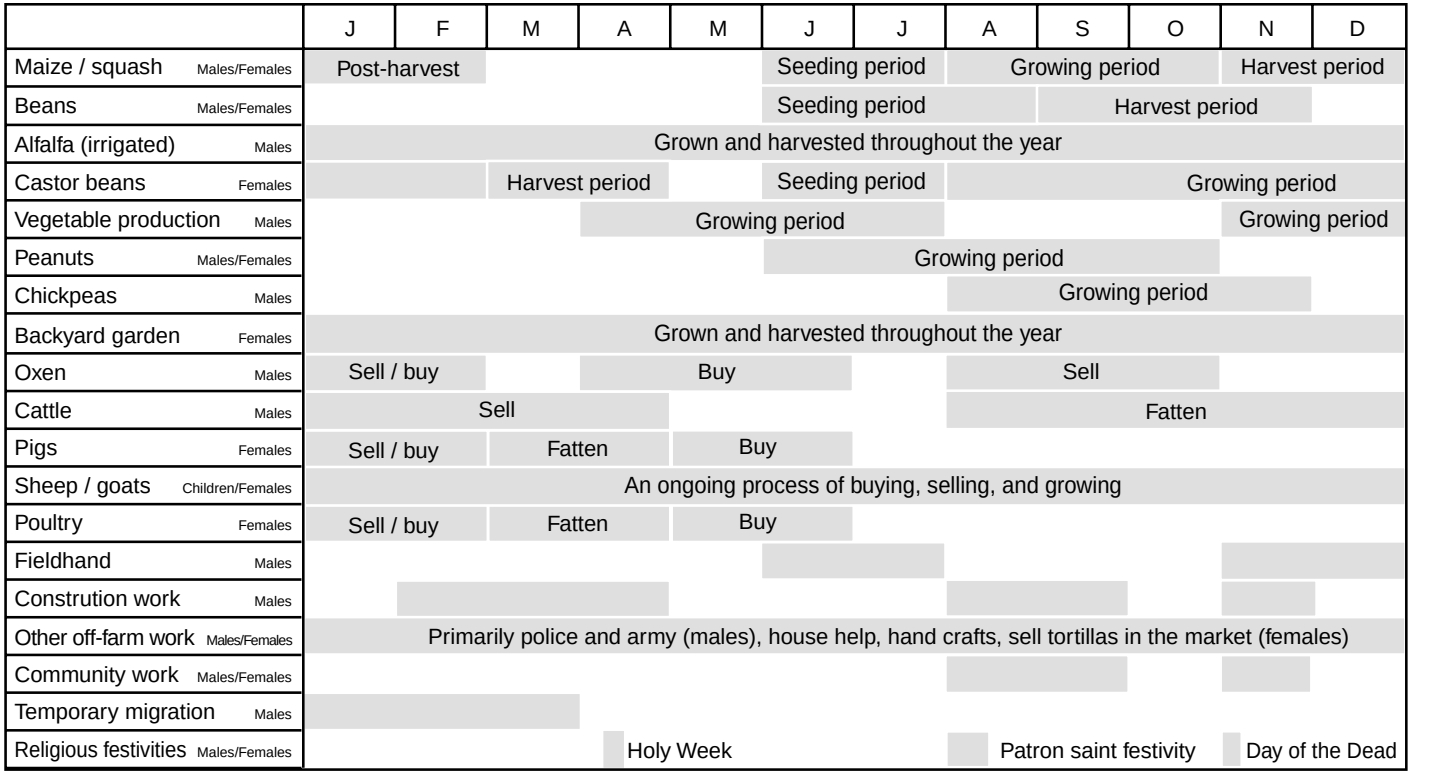

Figure 4. An example of a calendar of activities, Santa Ana Zegache, Oaxaca, Mexico.

type, such as waterlogging. They may tailor their crops, varieties, or management practices to the specific soil types, perhaps by applying different amounts or types of inputs or planting particular varieties. Therefore, explicitly taking into account the variability farmers recognize in their soils may be an important factor for the development and/or adoption of agricultural technologies. These taxonomies may be useful in defining where certain technologies may or may not be appropriate (i.e., recommendation domains). Furthermore, for scientists it may be also important to know this taxonomy to communicate more effectively with farmers.

Method: A group of informants from a community is assembled, ideally a mixture of people of different ages, resources, and genders. Researchers explain that they want to learn about the types of soils that exist in the community, including their positive and negative characteristics. Researchers explain that this knowledge is vital for understanding and developing solutions for soil problems faced by farmers.

The interviewer poses the question: *What types of soils are present in your community?*

The group lists each soil type. For each type, the interviewer should check whether there are subtypes by asking whether all soils of that type are the same, or whether there are different classes for that type. Once subtypes are identified, the interviewer asks the following questions for each type:

How do you identify this soil type?

What are its positive characteristics (advantages)?

What are its negative characteristics (disadvantages)?

It is important to identify responses that refer to the same concept, since people may express their ideas in different forms. This requires some judgment on the part of the scientist, but usually it is not difficult. As with the farmer classification, the responses may refer to some underlying property of the soil, which should be identified. Researchers then use this information to generate a table that synthesizes all of the data.

Example: This method was used in the Chihota Project to identify the soil types farmers recognized. Afterwards, their soil taxonomy was the basis for identifying and discussing the technological options they used to cope with soil infertility and whether these options were targeted to specific soil types or not. Farmers listed ten types of soil for agricultural use. Table 7 describes the four most important types. The descriptions are based on texture (i.e., particle size), fertility status, and color (the latter is used to distinguish subclasses). The advantages and disadvantages listed for each soil type refer particularly to its water-holding capacity, ease of work, inherent fertility, response to fertilizers and manure, tendency to become waterlogged; to its particular uses, such as use in gardens; and its appropriateness as a building material.

The two most common soil classes for maize production were the lighter textured soils, Jecha and Shapa. Jecha is a sandy soil of low fertility and poor water-holding capacity, which can easily become waterlogged, is easy to work, and is good for building. Shapa is a sandy loam soil of low to average fertility. Yields of crops grown on this type of soil may be low unless additional inputs are applied, but Shapa soils have better water-holding capacity than Jecha soils. Although they can also become waterlogged, Shapa soils

Table 7. Farmers' soil taxonomy, Chihota, Zimbabwe

Soil class	Subclasses	Description	Advantages	Disadvantages
Jecha	White Blackish Grayish	Sandy soil, coarse-grained, low fertility, used for building	Responds to manure application Can get good yields, even with inadequate rains Easy to work Good for building	Low fertility Low water-holding capacity Erodes easily Becomes waterlogged easily Can get very hot Difficult to farm, because of need to apply more inputs
Shapa	Black (dema) White (nhuke)	Sandy-loam soil, easy to cultivate, low fertility	Produces good yield, even with inadequate rains Average water-holding capacity Can hold water for long periods One can grow any crop Responds well to manure and fertilizer Easy to work Can be worked by hand	Low to average fertility No yield unless inputs added Gets waterlogged under heavy rain Crops fail if little rain Maize wilts easily when hot Not good for growing groundnuts
Rukangarahwe	Reddish Whitish	Gravel, mixture of fine and coarse-grained sands	Resists erosion Good yields if rains are good Does not get waterlogged Good for road construction Good for fruit tree production	Infertile Blunts farming implements Difficult to work (to plow, weed) Poor water-holding capacity Crops wilt with reduced moisture Difficult to plow deeply Needs too much water Many plants are cut during cultivation Harbors termites
Churu/Rechuru	Makura (upland soil, type of termite mound) Bani (fley soil, type of termite mound)	Termite mound soil, heavy texture, sticks when wet and cracks when dry	Can be used to improved soil High fertility Good yields if rains are good Used for molding and plastering Used as graveyards	Hard to dig Crops wilt with slight moisture stress Requires a lot of water to support plant growth Difficult to plow

Source: Bellon et al. (1999).

are easy to work but are not good for growing groundnut. The subclasses of Shapa soils depend on the position of the soil in the toposequence. The darker subclass, which is considered more fertile, is located lower in the toposequence; the whitish subclass is in the intermediate parts of the topsequence; and the grayish and least fertile subclass is found at the top. Although agronomists and soil scientists working in the area knew many of these characteristics, they did not know how farmers referred specifically to these soils. Therefore at a minimum this exercise enhanced the communication between scientists and farmers at a low cost to both.

The underlying soil properties of the taxonomy are texture, color, water-holding capacity, ease of work, inherent fertility, response to fertilizers and manure, and proneness to waterlogging. Aside from actual soil properties, particular uses (e.g., in gardens and as building material) were important in the taxonomy.

It is possible to study the relationship between the local taxonomy and objective soil properties. Researchers can sample each of the soil types that farmers identify and conduct physical and chemical laboratory analyses. For example, in the Chiapas Project, farmers identified five soil types: Tierra Negra, Tierra Baya, Tierra Colorada, Tierra Colorada Arenosa, and Tierra Cascajosa. Researchers sampled 104 fields that included the five soil types and analyzed the samples' chemical and physical properties. An analysis of variance using the soil classes as the grouping factor (Table 8) indicated that farmers' soil taxonomy discriminated among objective properties in their soils and that objective properties were consistent with farmers' perceptions.

Comments: In working with farmers' soil taxonomies, as with any other type of local knowledge, researchers must be cautious about making generalizations to other people or areas. Specific soil classes may change from one community to the next. Even within a community, researchers should check with farmers who did not participate in the taxonomy exercise to see whether they hold the same ideas about the soil classes and properties and to probe for additional classes. When researchers work in more than one community and similar soil names recur, they should always check to see whether the names refer to the same underlying soil or soil property or to something different.

Local Classifications of Climate

Goal: Identify factors relevant to farmers that define the climate during the growing season.

Rationale: Farmers recognize favorable and unfavorable climatic conditions for crop production. These conditions are associated with particular climatic events and conditions. Many of farmers' risk management strategies are ways of coping with these events and conditions, so identifying farmers' views of these events and conditions and their interaction is fundamental to understanding those strategies and designing technologies that are compatible with farmers' current practices. To a great extent, these factors reflect a value judgment, not a value-free description of a phenomenon. Farmers often refer to a "good" or a "bad" season for the crop of interest, and there are many different ways in which a bad season occurs.

Method: A group of informants from a community is assembled, ideally a mixture of people of different ages, resources, and genders. Researchers explain that they want a better

Table 8. Soil chemical properties by farmer soil class, Chiapas, Mexico

Property	Mean	Tierra Negra	Tierra Baya, Tierra Colorada	Tierra Colorada-Arenosa	Tierra Cascajosa	F-statistic	P-value
Organic matter (%)	6.1	8.7	5.9	3.3	1.7	9.7	.0000
pH	6.6	6.7	6.4	6.1	7.3	8.1	.0001
Sand (%)	49.0	38.4	48.9	65.0	68.1	9.7	.0000
Clay (%)	28.0	36.2	26.2	22.0	14.0	6.7	.0004
Observations (no.)	97	33	44	10	10	–	–

Source: Bellon and Taylor (1993).

understanding of which climatic characteristics constitute a "good" and a "bad" cropping season.

The interviewer poses the questions:

What are the characteristics of a "good" season?

What are the characteristics of a "bad" season?

Usually these characteristics refer to underlying climatic factors or events. These factors can be combined to create different "types" of seasons, some "good" and some "bad." Not all theoretical combinations are real or appear frequently. Researchers may need to relate the factors identified by farmers to actual rainfall data to identify relevant "types" of seasons in terms that are meaningful to farmers.

Example: This method was used in the Chihota Project as a framework for a later discussion of risk management strategies. Farmers were asked about the characteristics of "good" seasons and of "bad" seasons. Their answers reflected five underlying factors (Table 9): the onset of the rains, the end of the rains, drought in the middle of the cropping season, distribution of rainfall, and quantity of rainfall. By combining these factors, types of seasons can be identified. For example, one season begins in November, finishes in March, and has a mid-season drought. Another starts in mid-October, finishes in April, and has no break in rainfall in the middle of the season. These types of seasons can be used to discuss different management options to cope with climate-related cropping problems or to explore how climatic factors might affect a new technology (for example, how the late onset of the rains might affect the application of lime or the choice of a new variety).

Comments: Local classifications are more complex for climate than for soils, because climate is much more dynamic, changing from one year to the next, whereas soils change very slowly. Developing a classification of climate also requires a higher level of abstraction, because participants are trying to identify common aspects in climate patterns that occur throughout relatively long periods. People are notoriously bad at judging long-term trends. A classification of climate clearly entails more limitations than other classifications, but it can still be useful to systematize and discuss key aspects of climate and their impact on agriculture and other elements of farmers' livelihoods. It should be noted that the method presented here is not concerned with eliciting farmers' perception of climate data (see, for example, Gill 1991) but with identifying

Table 9. Underlying factors defining "good" and "bad" seasons according to farmers, Chihota, Zimbabwe

Underlying factor	Good season	Bad season
Onset of rains	Mid-October	After October
End of rains	April	December, March
Mid-season drought	–	Rains break for three weeks in mid-season
Distribution of rains	Even throughout season; allows periods of sunlight	High rainfall in April, low rainfall during grain filling stage
Quantity of rain	Rains give time to work in field	Excessive rains cause waterlogging, very long rainy season

conditions and events that farmers use to classify a season with regard to its impact on crop production.

Local Crop Taxonomies

Goal: Identify the different types (or farmer varieties[8]) that farmers recognize in one crop species, and identify the traits farmers find relevant for each type. (This method may also be used for different crop species rather than for varieties of a single crop species.)

Rationale: Small-scale farmers usually plant more than one variety of a crop, particularly if it is one of their most important crops, and they have their own categories for the different varieties or types. Each of these varieties has specific characteristics, some positive and some negative. By identifying the different varieties and their advantages and disadvantages, it is possible to recognize the crop characteristics that farmers value and how these are distributed across the varieties they plant. This information is valuable for improving breeding strategies (for example, by pinpointing which traits to improve) or for identifying new varieties that may interest farmers. Additionally, this information may be valuable for understanding farmers' incentives to maintain crop diversity on the farm, an approach to conserving genetic resources and biodiversity that is becoming more important.

Method: A group of informants from a community is assembled, ideally male and female farmers with a reputation for planting many different varieties. Researchers explain that they want a better understanding of the various types of a particular crop that exist in the community, including the positive and negative characteristics of each type. Researchers explain that this information is important for understanding the problems that farmers have with this particular crop and their possible solutions.

The interviewer poses the question: *What types or varieties of crop X* (e.g., maize) *does your community plant?*

Each of the types is listed. The interviewer checks whether each type is subdivided into finer categories and asks whether these categories are subdivided as well. *The interviewer continues until there are no finer categories.* Once all categories have been elicited, the interviewer asks the following questions for each one:

How do you tell this variety apart from other ones?

What are its positive characteristics (advantages)?

What are its negative characteristics (disadvantages)?

It is important to identify responses that refer to the same concept, since people may express their ideas in different forms. This requires some judgment on the part of the scientist, but usually it is not difficult. As with the other farmer classifications, the responses may refer to some underlying characteristic or property, and therefore it is important to identify them. Researchers can use this information to generate a table that synthesizes all the data.

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8 *Farmer varieties* (referred to as "varieties" in this manuscript) are the crop populations that a group of farmers recognize as distinct units. Each of these varieties combines a particular set of characteristics that farmers recognize, such as a certain yield potential, growing cycle, particular performance under biotic and abiotic stresses, response to management, or culinary and storage properties.

Example: This method was used in the Oaxaca Project to identify the diversity of maize types grown by farmers, and the results formed the basis for an analysis of the supply and demand of characteristics (a method presented in the next section of this manual). For simplicity, this example will focus only on the exercise carried out in one of the communities in the project, Santa Ana Zegache. This exercise was conducted with a group of eight farmers (two women, six men). They identified four types of maize, based on grain color: Blanco (white), Amarillo (yellow), Negro (black), and Belatove (red). They did not recognize divisions within these classes. The advantages and disadvantages of each type are presented in Table 10. The underlying characteristics of the variety taxonomy are yield, duration, ease of sale, consumption quality, and suitability as animal feed.

During the discussion, it emerged that planting date—and therefore the uncertainty of the duration of the growing season—was very important. Although in the earlier part of this exercise farmers did not identify any disadvantage associated with white maize, a key disadvantage became clear: white maize had a high yield, multiple uses, and was easy to sell, but it had the longest growing cycle. Its longer duration was a negative characteristic if the rains were delayed and it had to be planted late, because then the crop risked being exposed to drought and to frost. The other maize types had shorter growing cycles (white > yellow > black > red) and provided farmers with the flexibility to respond to the uncertain onset of the rains. If the rains arrived late, farmers could plant a shorter duration maize type. Farmers recognized the trade-off between duration and yield, and grain color was an indicator of this relationship. Although women particularly appreciated the colored maize types, they were difficult if not impossible to sell, which was not a great problem in their subsistence-oriented farming system. These insights emphasize that there is no "best" or "ideal" variety; farmers need and want diversity. Even the very desirable white type had problems. The results from Santa Ana Zegache confirm the idea that planting different maize types is, at least in part, a risk management strategy. They also show that grain color is an important "marker" that farmers use to make planting decisions.

Table 10. Maize types and their characteristics in Santa Ana Zegache, Oaxaca, Mexico

Maize type	Characteristic	Advantages	Disadvantages
Belatove	Red grain	Grows very fast	Low yield Not a lot of animal feed
Amarillo	Yellow grain	Good yield Faster growing	Not widely consumed Difficult to sell
Negro	Black grain	Fast growing	Very difficult to sell Lower yield
Blanco	White grain	Good for consumption (tortilla, atole) Used for everything Easy to sell	No disadvantage

In the case of Santa Ana Zegache, the classification and number of maize types was simple, but this is not always so. Figure 5 shows the complexity of the maize taxonomy produced by farmers in the Chiapas Project, which stands in sharp contrast to the simplicity of the Oaxacan taxonomy. Farmers in Chiapas grouped their maize varieties into three major classes: landrace (*criolla*), improved, and "creolized"[9] (*acriollada*) varieties. Each class comprised several maize types. Some landraces were further divided by grain color. The differences between the taxonomies from Oaxaca and Chiapas are partly explained by the fact that farmers in Chiapas are much more commercially oriented, even though subsistence production is also important. Although they had landraces with desirable characteristics, the farmers in the Chiapas Project had also been exposed to improved varieties that were well adapted to their conditions, and in fact they had modified some of the improved varieties to suit their needs (the creolized varieties).

Comments: Even within one community, the information elicited just from one group may be incomplete. It is necessary to probe further with other farmers or groups. Ideally, researchers should ask farmers to bring samples of the different crop varieties they recognize to the group discussion and ask them to classify the varieties together.

Farmers' classification of varieties may not necessarily coincide with researchers' classification. In Santa Ana Zegache in Oaxaca, genetic resource specialists collected samples of ten types of maize, including all four grain colors. Based on agromorphological characteristics, these types were classified into three classes (one class could include more than one grain color).

As with other types of local taxonomies, a local crop taxonomy may be valid just for the community where it was elicited. The same name may refer to different biological entities from one community to the next. It may be misleading to compare varieties from different communities using local taxonomies. "Maíz Blanco" from community A may not be the same as "Maíz Blanco" from community B.

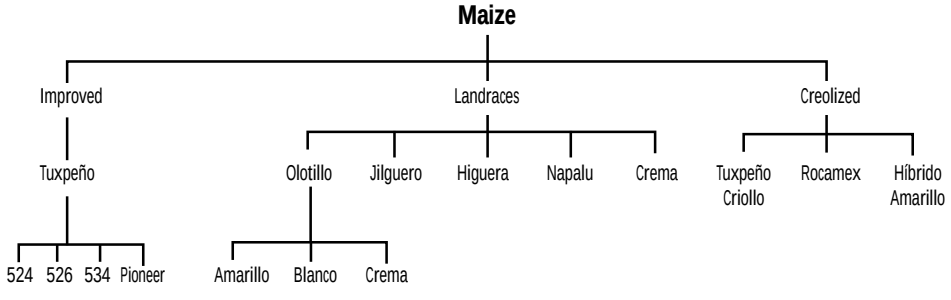

Figure 5. Classification of maize types in Vicente Guerrero, Chiapas, Mexico.

9 *Creolized maize varieties* are scientifically improved varieties that have been in the hands of farmers for several growing seasons and have been modified by them. These varieties usually are appreciated because they combine desirable traits of improved varieties with those of landraces.

Identifying Points of Intervention

Goal: Identify the technologies/practices to be developed and/or tested with farmers.

Rationale: The diagnosis of farmers' conditions usually reveals a large set of problems or constraints that farmers confront. The classification of farmers may show socioeconomic constraints, soil taxonomies may indicate problems with soils, and so on. Many of these problems cannot be resolved by research. If patterns of land inheritance discriminate against women, for example, there is little that an agronomist or a soil scientist can do, aside from noting the problem and considering how it may affect the technical solutions that can be offered to farmers to improve soil fertility.

Among the spectrum of problems uncovered in the diagnosis, it is fundamental to identify the areas of intervention where interaction between scientists and farmers can provide appropriate solutions through new technologies or practices. Obviously the particular expertise of the scientists working with the farmers will influence which problems can be addressed. Even so, the specific problems that should be addressed (and therefore the specific areas of intervention) are not necessarily easy to identify.

Method: A group of informants from a community is assembled, ideally a mixture of people of different ages, resources, and genders. Researchers explain that they want a better understanding of the informants' problems.

The interviewer poses the question: *What are your problems?*

The interviewer lists the responses. Since the informants' answers may refer to the same problem in different ways, once all problems have been identified, they should be grouped by similarity. For example, someone may say, "The crop does not produce," and someone else may say, "We get bad production." Both responses refer to low yields. Responses should be grouped in consultation with the informants, by saying, for example, "Do you agree that the statements 'The crop does not produce' and 'We get bad production' refer to the same problem? If so, let's agree on a common way of expressing it."

Once the problems have been consolidated, the interviewer asks the informants to rank them by asking informants which problem they consider to be the most important, which is second most important, and so on. There may not be consensus; different informants may rank problems differently. The interviewer notes the different rankings for each problem. Alternatively, the interviewer can ask each informant to rank the problems, and then use the average ranking or the most frequent ranking to order the problems by importance. Another strategy is to ask informants to vote on the importance of each problem.

This exercise helps researchers identify the general areas of intervention where they can make a contribution. It also helps researchers to gauge the potential importance of each intervention, because they can see the entire range of problems that farmers face and the importance of each. *The farmers' answers may range over a very broad range of topics, including all sorts of things that agricultural research can do nothing about, and they may raise people's expectations. Therefore, researchers should be*

extremely careful to be clear to farmers about what the researchers can and cannot do. The understanding that researchers may have gained with the use of farmers' classification of themselves may be helpful in guiding and focusing the discussion.[10]

Once the general areas of intervention have been identified, researchers should repeat the exercise to identify and rank the specific problems that are suitable for research. *At this stage, it is fundamental that researchers keep the discussion focused on areas where they can make a contribution. Keep the discussion as specific as possible.* For example, the general concern of "low yields" may consist of more specific problems, including late planting, insect attack, lack of irrigation, and difficulty in purchasing fertilizers.

After problems have been identified and ranked, the group of informants and researchers should discuss possible options for addressing them.

The interviewers asks the informants: *What do you think can be done to improve/ solve this problem?*

The pros and cons of the different options identified can be discussed and the group can agree how to proceed. It is important that the responsibilities of farmers and scientists regarding future action are defined very clearly in terms of what each will and will not do.

Example: A maize agronomist and a rural sociologist used the method described above to query a group of very poor, subsistence-oriented, indigenous farmers in a small community in the state of Puebla, Mexico, about their problems. [11] The group comprised 100 farmers, 40 of them female, ranging in age from 20 to 60. This number of participants is unusually high and reflects a high degree of social organization within the community. After a long discussion in which researchers used their knowledge of the area and the communities to encourage farmers to focus on specific issues, the group mentioned the following problems:

- low prices for coffee and pepper;
- lack of labor for harvesting coffee;
- lack of infrastructure to dry and process coffee, which led to marketing problems because farmers could sell coffee only as berries, not beans;
- poor transportation infrastructure;
- insufficient maize production to cover their needs;
- difficulty selling other agricultural products, such as tropical fruit (prices were so low that was not worth harvesting the fruit);
- lack of sufficient drinking water during the dry season; and
- lack of doctors and medicines, although the community had a health center.

The group was asked to rank the problems in order of importance. Problems associated with coffee and maize were equally important, followed by the lack of services (water and health), the lack of transportation infrastructure, and the difficulty of marketing tropical fruit. The scientists participating in the exercise explained to the group that their expertise was in maize, and unfortunately they could give little assistance with problems related to

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10 Other methodologies can be used to address these issues in a very focused manner, such as causal analysis with farmers (Tripp and Woolley 1989).

11 This example was kindly supplied by Angel Pita and Xóchitl Juárez from the Universidad Autónoma de Chapingo, Mexico.

coffee, pepper trees, services, or infrastructure. The remainder of the exercise focused on insufficient maize production.

Participants were asked about their specific problems in maize production. They mentioned that while their local maize varieties were good, the varieties nevertheless had some problems. The main problem was that the varieties were tall and vulnerable to lodging, and the participants wished to test new maize varieties. The group mentioned high storage losses as another problem, as well as losses to pests in the field (white grubs and fall armyworm). They also wanted to know about other types of fertilizer. The fertilizer formulations they used for maize were originally provided for coffee production and had low nutrient concentrations (e.g., 18-12-6 N-P-K). The ranking of these problems in order of importance was: 1) maize varieties, 2) fertilizers, 3) storage losses, and 4) field pests.

Based on this exercise, several specific areas of intervention were defined:
1) evaluating new maize varieties, both local and external, with farmers;
2) conducting simple experiments with different fertilizer types and rates; and
3) evaluating the use of metal silos for storing maize. Although farmers wanted to evaluate the use of pesticides, they decided against it when they learned of the expense and of the need for special handling to avoid health risks.

Comments: An important role for scientists participating in this type of exercise is to provide their analytical skills to identify the causes behind the problems and propose solutions that may not be apparent to farmers. Farmers know their environment and circumstances better than anyone, but in many instances the causes of many of their problems may not be evident to them, and scientists can explain those causes. For example, farmers may not understand the workings of supply and demand. When they see that the price of a crop increases, they may all plant it the next season, perhaps increasing supply so greatly relative to demand that the price falls substantially. Nor may farmers understand decreasing marginal returns to an input. They may believe that applying double the amount of fertilizer will increase production twofold, which may lead them to waste the input without obtaining the expected results.

In summary, researchers can propose new options that may be unknown to farmers, such as conservation tillage for areas with erosion or where soil preparation is a constraint. Researchers can also provide new knowledge to help farmers understand problems better; with pest control, for instance, researchers can provide knowledge about pests' reproductive cycles or the role of beneficial insects.