Rapid Rural Appraisal and Agroecosystem Analysis: A Case Study from Northern Pakistan

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Introduction

This paper describes an attempt to combine Rapid Rural Appraisal (RRA) and Agroecosystem Analysis in the context of a development project. The workshop technique of Agroecosystem Analysis was originally designed to aid the identification and formulation of key questions for research. Participants in the workshops were university or research institute workers, although often there were development specialists present. The outcomes of the workshops were agreed programmes of research, applied in orientation but not necessarily leading to immediately applicable results. In this paper I discuss the potential value of the technique as an aid to determining agreed programmes of development, where the emphasis is on action. Such a goal requires a response that is both rapid and cost effective - hence the introduction of RRA as an integral component of Agroecosystem Analysis.

I begin with a brief summary of Agroecosystem Analysis and then describe how it has been adapted to serve a development objective. Its first application in this form was conducted for the Aga Khan Rural Support Programme as an aid to planning the development of some 400 villages in Northern Pakistan. I present a brief introduction to this Programme and to the region and then describe the analysis of two of the villages, emphasising the RRA techniques that were employed and the subsequent methods of dealing with the RRA data in the Agroecosystem Analysis workshop.

Agroecosystem Analysis

The technique of Agroecosystem Analysis and its underlying concepts were first elaborated in 1978 (Gypmanasiri et al 1980) and have subsequently evolved in a series of workshops held in Thailand and Indonesia (Conway, 1985a; KEPAS, 1984, 1985a,b,c; KKU-Ford Cropping Systems Project, 1982a,b; Limpinuntana and Patanapair, 1982). It is based upon a number of interlinked assumptions.

The first is that agricultural land use in any region can be represented as a set of more or less distinct agroecosystems, typically arranged in a hierarchic fashion. Each agroecosystem also has a characteristic behaviour that is summarised by four interconnected system properties (Conway, 1982, 1983,1984, 1985b), namely:

Productivity, which is the net increment of valued product per unit of resource (eg land, labour, energy or capital) and is commonly measured as annual yield or net income per hectare, or man hour or unit of energy or investment.

Stability, which is the degree to which productivity remains constant in spite of normal, small scale fluctuations in environmental variables, such as climate, or in the economic conditions of the market; it is most conveniently measured by the reciprocal of the coefficient of variation in productivity.

Sustainability, which can be defined as the ability of a system to maintain its productivity when subject to stress or perturbation. A stress is here defined as a regular, sometimes continuous, relatively small and predictable disturbance, for example the effect of growing soil salinity or indebtedness. A perturbation, by contrast, is an irregular, infrequent, relatively large and unpredictable disturbance, such as is caused by a rare drought or flood or a new pest. Unfortunately, measurement is difficult and can only be done retrospectively. Lack of sustainability may be indicated by declining productivity but, equally as experience suggests, collapse may come suddenly and without warning.

Equitability, which is a measure of how evenly the productivity of the agroecosystem is distributed among its human beneficiaries. The more equitable the system the more evenly are the products, the food or the income shared among the population of the farm, village, region or nation. It can be represented by a statistical distribution or by a measure such as the Gini coefficient.

A further assumption is that these system properties are determined, in turn, by a limited number of key functional relationships and management decisions. Thus to understand the essential behaviour of an agroecosystem or to produce significant improvements in its performance it requires that these relationships and decisions are identified and themselves understood. In practical terms this means that the research worker or development specialist has to define and answer a limited number of key questions. These questions may ask what are the key relationships or decisions and how do they function in determining the system properties and their interactions?

The next assumption is that the identification and definition of these key questions for one or more agroecosystems is best approached by bringing together a wide range of multidisciplinary experience, particularly spanning the natural and social sciences, to carry out a joint analysis. This is furthered by a workshop environment, by a structured but flexible procedure and by an analysis of the agroecosystem in terms of
four basic patterns – space, time, flows and decisions – which are assumed to underly the central system properties. This pattern analysis depends on the interactive use by the workshop participants of a large number of simple dioristic models, that is maps, transects, graphs, flow and bar diagrams, decision trees and venn diagrams.

Agroecosystem Analysis for Development

The development version of the Agroecosystem Analysis procedure is modified by adding an extra phase after the identification of key questions in which guidelines and working hypotheses for development are identified. Following this the proposed innovations contained in the hypotheses are then assessed and the final list of development priorities is produced (Figure 1).

To meet the time constraints of development programs the workshop itself, normally lasting a week when the objective is research questions, is reduced to two days and follows a fairly strict timetable (Table 1).

Table 1  Timetable for Agroecosystem Analysis for Development Workshop (Details of the organisation of such a workshop are given in Conway 1985c)

Day 1
Introduction to the workshop
Overview of development area and project
Briefing on case study data
Case study teams:
  a. System definition
  b. Pattern analysis
  c. System properties
  d. Key questions
  e. Guidelines and working hypotheses for development

Day 2
Presentations by case study teams
Discussion of key questions, guidelines and working hypotheses
Innovation assessment
Agreed development priorities
Preliminary plans

Figure 1. The procedure of agroecosystem analysis for development (Conway et al., 1985)
The Aga Khan Rural Support Programme (AKRSP) is a private, non-profit development company which began to work in Northern Pakistan in 1983. Its primary objectives are to reduce poverty in the area and to develop local capacity to identify and make use of productive opportunities. This is accomplished through the organisation of small farmers into broad-based economic coalitions, called Village Organisations, which then provide the vehicle for physical infrastructure projects, extension training, the provision of agricultural inputs and credit, and income generating activities for women.

A central principle of the programme is that development planning should be based in the villages and should thus be able to take account of significant socio-economic and ecological variations between and within villages. The first three phases of the project cycle - identification, preparation and appraisal - are thus accomplished through a series of interactive dialogues - termed the Diagnostic Survey - which takes place between the villagers and the AKRSP. The General Manager initiates the first dialogue with a village by explaining the objectives and methods of AKRSP; and then inviting them to identify income-generating projects that would benefit most of the households in the village and that could be undertaken by the villagers themselves. Almost invariably, villagers are able to agree on a project of overriding importance. Typical such Projects include the construction of irrigation channels and siltation tanks, and of access roads and bridges. The second series of dialogues involves a feasibility study of the projects proposed and the preparation of blueprints and cost estimates. In the third series the Village Organisation is created and an agreement is reached as to how the projects will be planned, implemented, managed and maintained. The average cost of each PPI project is about 125 thousand rupees. The AKRSP provides grants for these initial projects but the Villagers are also expected to make savings for which the Village Organisation takes collective responsibility. These forms the security which enables the AKRSP to underwrite loans from the commercial banks for subsequent development activities in the villages.

To date the programme has reached 450 villages in the districts of Gilgit, Chitral and Baltistan. There are approximately 400 Village Organisations who have initiated some 230 PPI projects. By the end of 1984 114 of these projects had been completed. The VO's had also accumulated an impressive total of 5.87 million rupees and established a record of over 90% repayment of their loans (AKRSP, 1983, 1984).

The successful implementation of the PPI project phase of the programme has established the basis of a considerable potential for agricultural development. The newly irrigated land is ready for exploitation and the new access to markets provides an incentive for improvements in existing production and the introduction of new patterns of crop and livestock husbandry. At first sight the opportunities appear to be varied and considerable and the AKRSP is faced with the task of identifying, assessing and ranking them in order of priority for support through the loan programme. This task largely falls to the small team of development specialists and to the Social Organisers who are responsible for the continuing development dialogue with the VO's. It is a highly complex task which nevertheless has to be accomplished speedily and at minimum cost. In early 1985 discussions were held between the Aga Khan Foundation, the main funder of the AKRSP, and the author to explore the possibility of using Agroecosystem Analysis as an aid in setting priorities. The consequence was an exploratory workshop held in May of 1985 (Conway et al, 1985), the main results of which are reported here.

The Programme Area

The area covered by the AKRSP comprises the upper watershed of the Indus River lying in the Gilgit, Chitral and Baltistan districts of Northern Pakistan. It contains a population of approximately 700,000, growing at 3.5% per annum, and with, on average, 1.06 ha of cultivated land per person. It also contains some of the highest mountains of the world, the Karakorams, with a large number of peaks over 20,000 ft. The valleys are very narrow and in some places only a few kilometres separate different elevations of over 15,000 feet. The other major characteristic of the region is the extremely low rainfall, between 2 and 6 inches per annum, which creates a desert environment. In consequence agriculture is almost wholly dependent on irrigation tapping the snow melt at the base of the glaciers. In physical terms agriculture is thus constrained by the lack of suitable sites, the absence of soil, and the absence of water. This explains the considerable productive potential of irrigation channels constructed over long distances and with great engineering skill to bring water and silt to suitable areas of land.

For the purpose of the workshop it was decided to concentrate on Gilgit district and to take two contrasting villages as case studies. These were Passu, which lies in the middle reaches of the Hunza river, and Oshkhandass, which is just south of Gilgit on the Gilgit river.

Passu is a small, high altitude (8000 ft) village with cropland and summer pasture. It is also characterised by a very successful village organisation which, with AKRSP support, has nearly completed a new irrigation channel that will eventually quintuple the existing crop land. By contrast, Oshkhandass is a larger, relatively young village, established only 50 years ago at 4,700 feet near to Gilgit, and lacking summer pasture. The village organisation has been less successful than at Passu and the PPI project to construct a sediment tank failed.

The Method of Rapid Appraisal

A typical research orientated Agroecosystem Analysis workshop is preceded by a month or more of relatively intensive data gathering in the case study sites and the collection
together of all relevant secondary data. Development teams such as those of the AKRSP, however, can rarely afford this amount of time. The solution tried here is to restrict the preliminary data collection to a single day's Rapid Rural Appraisal at each site.

As is apparent from this conference RRA covers a wide range of techniques which have in common the objective of quickly acquiring critical information about or from an area during one or more brief visits. The techniques rely primarily on careful observation coupled with semi-structured interviewing of farmers and local leaders and officials. The objective may be to answer a specific question posed by research or development, the topical RRA, or, as in the case of RRA as applied to Agroecosystem Analysis, the task is primarily to acquire sufficient information to produce the essential diagrams for pattern analysis.

Experience gained in research orientated Agroecosystem Analysis workshops suggests that the following are the most useful basic set of diagrams:

1. A diagrammatic history of the area
2. Sketch map showing key features and agroecological zones
3. One or two transects with zones and problems
4. Seasonal calendar
5. Bar diagram of sources of income for selected farmers
6. Flow diagrams of production and marketing
7. Decision tree for major livelihood systems
8. Venn diagram of institutional responsibilities for decision making

Although even this restricted list represents a considerable amount of information, it was felt that an efficient field team of four to six people should be able to complete the task in a single day in the field.

The field team consisted of: the author, an agricultural ecologist, M. Ali Mian, a soil scientist, Zahir Ali, an agriculturalist and Mehreen Hozain, a biologist, accompanied on the visit to Pasu by A. Jami Sahl, and to Oshkhandass by Essa Khan. The two latter gentlemen are members of the staff of AKRSP at Gilgit but are also inhabitants of the two respective villages. It was planned to include a social scientist but this proved not possible.

Simple maps had been prepared for the villages beforehand but otherwise all the information was acquired during the visit.

Maps and Transects

These were constructed by walking through the villages along two transects, chosen by eye to provide a good representation of the variation within the village. During the walks observations were made by eye and farmers who were encountered were questioned.

The primary purpose of the maps is to delimit the main agroecological zones within the village, again chosen subjectively as being distinct agroecosystems in terms of one or more ecological, agricultural, social or economic features. In the case of Pasu the different terraces appeared to be the obvious basis of zonation (Figure 2).

The transects also reflect the zones and provide an opportunity to characterise them in terms of the crops and livestock husbanded and the different problems encountered. An attempt was also made to record on the maps an assessment of the productivity and sustainability of each zone (Figure 3).

The Seasonal Calendar

This was constructed partly during the transect walks, partly from the knowledge of the villagers on the study team and later in interviews with a group of farmers and village leaders.

The seasonal calendar is seen here as a development from the traditional crop calendar, being explicitly concerned not only with cropping and related activity patterns but with livestock and other sources of livelihood (Figure 4).

Because no quantitative information existed on climate and labour these were assessed qualitatively on the basis of farmer interview. Farmers were asked which was the wettest month (August) and then asked in sequence how the months following it were compared (July "virtually none", June "a little", April and May "half of August" etc). They also estimated the August rainfall as "about 5". A similar approach was used to obtain the pattern of labour demand.

Bar Diagram

During the transect walks, individual farmers were chosen, subjectively, as representing "large, medium and small farmers" and were engaged in a more intensive, structured dialogue aimed at assessing their holdings by types of crop and livestock. Information was also obtained on the size of the family and the extent to which the subsistence demand was met (Figure 4).

In the case of Pasu the diagrams indicate that the proportion of different sources remains remarkably consistent over the range of holdings.

Flow Diagrams

These were constructed largely from the group interview with a number of farmers and village leaders and assisted by the village on the team. Only two of the three diagrams were constructed for each village, the system chosen subjectively in terms of its present or future potential in the village. The diagrams were designed to show the interrelationships between production and marketing and the costs and returns at different stages in the cycle (Figure 6).

Decision Trees

The decision trees were constructed after the transect
<table>
<thead>
<tr>
<th>Crops</th>
<th>Wheat</th>
<th>Garley</th>
<th>Potatoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comments</td>
<td>Recent</td>
<td>Cultivation</td>
<td>More</td>
</tr>
<tr>
<td>Productivity</td>
<td>Barley 3-4 Mds. (M)</td>
<td>Wheat 50-75 (M)</td>
<td>Potatoes 25-45 (M)</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Wheat</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Figure 2. Agroecological zones of Passu (Conway et al, 1985)

Figure 3. Transect of Passu (Conway et al, 1985)
Figure 4. Seasonal calendar for Yassu (Conway et al., 1985)

Figure 5. Bar diagram showing sources of income, amounts of wheat purchased, and size of working population for three farmers in Passu (Conway et al., 1985)
walks. The distinctive livelihood systems were identified during the walks by observation and from farmer interviews. The factors determining choices were also obtained from these interviews and from the group discussion with farmers and village leaders. Note that the categories of the decision trees are livelihood rather than farming systems, since the intention is to encompass all forms of livelihood and not just agriculture (Figures 7, 8).

The decision trees for Passu are basically very simple because of the undifferentiated nature of the livelihood systems.

Venn Diagram

The Venn Diagram, indicating the degree of interrelationship between the different decision makers in the village, was constructed during the group interview with the farmers and village leaders (Figure 9). Although revealing a complex pattern of overlap of decision making it also indicates where linkages could be made.

The Historical Record

This record of major events in the life of the village was similarly constructed during the group interview (Figure 10).

The Analytical Workshop

Following the RRA a day was spent on the data from each village, primarily transferring it to overhead transparencies and making photocopies for the workshop participants.

The workshop was held three days later and was attended by about thirty men. Participants included the AKSP staff from Gilgit, most of the social organizers, and representatives of other development agencies in the area and the Aga Khan Foundation. The timetable was as indicated in Table 1. After a short introductory session participants followed the procedure as described in Figure 1. Two case study terms were formed, one for each village.

Objectives

The workshop defined its objective as:

"to identify working hypotheses for development that will lead to improvements in the agricultural productivity on a stable, sustainable and equitable basis."

System Definition

The case study team members were asked to identify the principal systems and their interrelationships. Simple diagrams were produced in order to define the boundaries of the systems in their case study. In the case of Passu, for example, it is clear that although the village is tiny, consisting of only 60 households, the resource base extends over thousands of square miles (Figure 11).
Figure 8. Decision tree for farming systems on new land in Passu (Conway et al., 1985)

Figure 7. Decision tree for livelihood systems in Passu (Conway et al., 1985)
Figure 9. Venn diagram of institutional overlap in Passu (WO = Women's Organisation) (Conway et al, 1985)

Figure 10. Historical profile of Passu (Conway et al, 1985)
Following this definition the system hierarchies were constructed (Figure 12), using the agroecological zones described during the RRA as the basic systems.

Pattern Analysis

The case study team members were given the following tasks:

1. Maps
   a) discuss correlations and factors in land use
   b) identify new forms of land use

2. Transects
   a) discuss problems
   b) discuss system properties
   c) suggest potential solutions to problems
   d) identify potential intensifications

3. Seasonal calendars
   a) discuss constraints
   b) discuss opportunities

4. Long term trends
   a) discuss past trends
   b) predict future trends

5. Bar diagrams
   a) discuss sources of production and income
   b) identify new potential sources of income

6. Flow diagrams
   a) discuss productivity, stability, sustainability and equitability of flows
   b) identify missing links
   c) identify potential intensification

7. Decision trees
   a) discuss key factors in decision making
   b) identify possible new farming and livelihood systems

8. Venn diagrams
   a) discuss missing links and gaps in organisation
   b) identify possible new organisational links
System Properties

Following pattern analysis the working group members were asked to summarise what they had learnt of the system properties and to tabulate the most important contributing factors and processes (Table 2). They were also asked to identify the trade-offs between these properties and their implications for development.

Key Questions, Guidelines and Working Hypotheses

Key questions, guidelines and working hypotheses arise throughout the procedure, during system definition, pattern analysis and the discussion of system properties. Participants were asked to record these as they emerge and then collectively revise them in the light of all the information available.

Key questions for development may be of the form:

"How can soil development be speeded up while at the same time providing a high return?"

Such questions then generate a set of guidelines and working hypotheses. Guidelines are based on well-established knowledge, derived from experience in the area or elsewhere, or reflecting fundamental principles of development. A guideline relating to the above key question might then be:

"Use deep rooted, high quality fodder crops and manage them intensively."

The related working hypotheses reflect a greater uncertainty about development. They are based on knowledge and experience and on the previous steps of analysis but still need to be tested. A working hypothesis related to the key question might be:

"Soil development can be most profitably speeded up by planting alfalfa at a high density, cutting twice a year and resowing after ploughing in every three years."

The working group members were asked to:

a) Identify and write down each key question
b) Identify and write down guidelines
c) Identify, clearly define and write down working hypotheses
d) Justify hypotheses and describe underlying reasoning (three or four sentences)

Table 3 lists some of the key questions, guidelines and working hypotheses for development generated for the village of Passu.
Table 2: Key variables and processes affecting the system properties in villages of the Northern Areas of Pakistan (Conway et al., 1985)

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRODUCTIVITY</strong></td>
<td><strong>Constraints, limiting factors</strong></td>
</tr>
<tr>
<td>Factors increasing productivity</td>
<td>Land shortage</td>
</tr>
<tr>
<td>Karakoram Highway</td>
<td>Water shortage</td>
</tr>
<tr>
<td>Land development</td>
<td>Weeds</td>
</tr>
<tr>
<td>Fertilisers</td>
<td>Seasonal labour shortage</td>
</tr>
<tr>
<td>New varieties</td>
<td></td>
</tr>
<tr>
<td>Seed potatoes</td>
<td></td>
</tr>
<tr>
<td>Credit</td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td></td>
</tr>
</tbody>
</table>

**STABILITY**

<table>
<thead>
<tr>
<th>Stabilising factors</th>
<th>Destabilising factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated livestock/crops</td>
<td>Crop diseases</td>
</tr>
<tr>
<td>Co-operative marketing</td>
<td>Crop pests</td>
</tr>
<tr>
<td></td>
<td>Livestock diseases</td>
</tr>
<tr>
<td></td>
<td>Temperature fluctuations</td>
</tr>
</tbody>
</table>

**SUSTAINABILITY**

<table>
<thead>
<tr>
<th>Processes preventing collapse</th>
<th>Stresses and perturbations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmyard manure</td>
<td>Glacier movement</td>
</tr>
<tr>
<td>Crop rotation</td>
<td>Mudflows, avalanches</td>
</tr>
<tr>
<td></td>
<td>Earthquakes</td>
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<tr>
<td></td>
<td>Erosion</td>
</tr>
<tr>
<td></td>
<td>Potato virus</td>
</tr>
<tr>
<td></td>
<td>Pesticide use</td>
</tr>
</tbody>
</table>

**EQUITABILITY**

<table>
<thead>
<tr>
<th>Factors increasing equity</th>
<th>Factors producing inequity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional co-operation</td>
<td>Sale of land</td>
</tr>
<tr>
<td>Village organisation</td>
<td>Education</td>
</tr>
<tr>
<td>Rotation of pasturing</td>
<td>Emigrant labour</td>
</tr>
</tbody>
</table>

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Table 3: Examples of key questions (KQ), guidelines (G) and working hypotheses (WH) for development for the village of Passu (Conway et al., 1985)

1. **KQ:** How can soil development on the new land be speeded up while at the same time providing a high return?
   **G:** Choose crops that facilitate soil development; do not plant wheat, barley or potatoes for at least five years; start with high potential zone (3rd terrace); set up small experimental, observation area; plant windbreaks
   **WH:** 3rd terrace should be planted with apples, peaches, apricots, cherries and alfalfa
   2nd terrace should be planted with willow, rubinia, alfalfa and perennial grasses

2. **KQ:** How can the land be best used after reclamation?
   **G:** Conduct experiments before large scale planting
   **WH:** After 7 years 25% of land for potatoes, the rest to wheat, barley and fruit trees
   Alfalfa and forest trees most suitable for 2nd terrace

3. **KQ:** How can health and quality of seed potatoes be maintained and improved?
   **G:** Priority on control of diseases, insect vectors and eel worms
   **WH:** Isolate fields at over 200 feet apart and rotate 1 year in 4 for potatoes

4. **KQ:** What is the potential for catch crops without incurring declining yields?
   **G:** Must fit from July/August to October; animals must be kept separate; organic manure as fertiliser must be added or legume grown
   **WH:** Peas, radish, turnip, vetch may be suitable

5. **KQ:** How can women and older children be more productively involved in development?
   **G:** Concentrate on skilled activities
   **WH:** Train women and adult children for such tasks as alfalfa processing, seed potato production, milk production and processing of curds
Innovation Assessment

Contained within the guidelines and working hypotheses are a number of proposed innovations which may be technological or socio-economic in character. The next stage is for the whole workshop team to assess these on a number of criteria and assign priorities. One set of criteria are the system properties or indicators of performance and each innovation needs to be assessed for its impact (positive or negative) on productivity, stability, sustainability and equity. Estimates also need to be made of the cost of the proposed innovation, the time horizon over which its benefits can be expected and its technical and operational feasibility (Table 4). These assessments are made in terms of the village agroecosystem as a whole eg., in terms of village level productivity, or the cost to the village. Once this is done for all the innovations they can then be ranked by the workshop participants in terms of their priorities.

Research Design and Implementation

The remaining phase of the procedure is one of conventional development activity. The hypotheses are tested as appropriate: by farmer or extension trials, or by development experiments, and these trials carefully monitored.

Some of the hypotheses can be tested directly; others, however, may need further refinement because the information gathered in the pre-workshop RRA is inadequate. There may be a role here for post-workshop RRA's of the "topic" variety described elsewhere in this conference.

Discussion

The RRA and following workshop were regarded by the participants as highly successful and as a consequence two training courses are planned, one in the techniques of RRA and the other in the techniques of Agroecosystem Analysis. These will be primarily attended by the Social Organisers. The aim is to provide them with sufficient confidence to undertake further exercises of this kind as part of the process of determining priorities for the villages for which they are responsible.

"Success", so far, of course, is largely a subjective judgement by the participants. They generally agreed that the approach enabled them to gather a better understanding of the two villages and to produce what appeared to be a reasonable list of development priorities. This was also achieved quickly and at relatively low cost. However, the eventual test of success will be whether the development programme produced as a result of this approach has been effective in terms of the stated objectives of the AKRSP. This, of course, cannot be judged for another five years or so.

The RRA component clearly needs further refining. Only additional experience will show whether the tasks set for the RRA can be reasonably completed in a single day, particularly where villages are larger or more varied. The RRA team was fortunate
having members who came from the villages and were educated and articulate. This undoubtedly made the appraisal easier, although it may have introduced certain biases. The need for greater efficiency and speed in the RRA is likely to lead to a more codified approach in the future, but this will undoubtedly be at the expense of flexibility and informality which are valuable for uncovering the unexpected and for stimulating serendipitous responses. This trade off will be constantly assessed as the approach is further developed.

Acknowledgements

The workshop was made possible through the support of the Aga Khan Foundation of the United Kingdom and I am grateful to Mr. Amir Kassim of the AKF(UK) and to Mr. Robert d'Arcy Shaw of the AKF head office in Geneva for their encouragement and participation in the workshop. I also wish to thank Mr. M. Ali Mian of the Pakistan Soil Survey who helped guide the RRA and the Workshop, Dr. Zahir Alam and Mr. Tariq Husain who chaired the working groups and the other members of the RRA team, Ms. Neelam Husain, Mr. Essa Khan and Mr. A. Jami Sakhi.

Finally I would like to express my gratitude to the General Manager of the AKRSP, Mr. Shoaib Sultan Khan. Such of the success of the Programme is due to his wisdom, enthusiasm and energy. I feel privileged to have been able to contribute to this programme and I am grateful for the encouragement and hospitality extended to me.

References


