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Design and testing procedures in livestock systems research: An agro-pastoral example

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Farming systems research (FSR) seeks to employ the skills of scientists most directly in the service of improving the welfare of small farmers. Livestock systems research (LSR) is no different except that livestock systems are two stage systems that necessarily demand different approaches to some of the problems of research in the field.

Rohrbach (1980) introduced a paper on FSR by stating that 'farming systems research is a philosophy and methodology of agricultural research for the development of improved technologies appropriate to small farmer needs and circumstances'. He claimed that there are very few controversial issues in farming systems research (due to a degree of agreement over the basic value and character of this type of research. Those issues which remain most significant to practitioners cannot he resolved in the process of debate per se. 'These issues, which primarily relate to questions of methodology, organisation and implementation, are in the process of being resolved by experience.' In concurrence with that opinion, and in view of the innumerable texts on farming systems research that already exist, this paper will avoid repetition of argument and rather concentrate on lessons drawn from the experience of the ILCA Subhumid Programme in the practice of LSR. In order to keep the paper to a manageable length it will concentrate on issues on which FSR and LSR differ.

Another author who is particularly appropriate to discussions of ILCA's work is John Dillon because he reviewed systems research for the Consultative Group on International Agricultural Research (CGIAR). He has stated 'that man, not cations or nodules or rumen flora of crop varieties or livestock species or dollars,

consumates the system must be a basic text'(Dillon, 1973). He stresses the need 'to take a teological view that effects may be due to the purposes they serve and only a holistic approach, with openness and teamness through interdisciplinary endeavour, can lead to the capturing of adequate understanding of a system for purposes of improving performance.' He points out 'the need for a structure which will facilitate a synthesising, integrative, team-oriented outlook rather than one that is analytical, compartmentalising and disciplinary and that the agricultural system is a purposive one involving physical, biological and social parts and that it operates within an environment having significant purposive components.' He also notes that 'adoption in the real world is a crucial factor and hence implies consideration of communication and extension.'

Background to source of the case examples

ILCA subhumid programme

The subhumid programme is charged with a responsibility for researching ways and means of enhancing the welfare of sedentary livestock producers through increased cattle and small ruminant production.

The programme is based in Kaduna in northern Nigeria in an ecological zone delineated by the 1 000 mm and 1 500 mm isohyets. With its good rainfall and radiation (180 - 270 growing days) it is an area of high potential production. However it is relatively underutilised because of tsetse-borne sleeping sickness and trypanosomiasis, though this situation is changing at a rapid pace. Farmers are moving in, extending arable cultivation and at the same time reducing tsetse habitats. Hard on their heels the formerly nomadic Fulani cattle-men are settling and becoming mixed crop-livestock producers. Whilst the settled agropastoral Fulani are the prime clients of the LSR they are so closely interlinked with the arable farmers that both communities have to be included in the research.

The 'pre-research model' adapted by Kaufmann (ILCA, 1979) from Johnson et al (1971), indicated that malnutrition is the single most important constraint to range livestock production. It is also the factor that is most sensitive to correction with available tech-

nology. Thus improving the nutritional status of the herds is the paramount objective of the programme. Since there is an inadequate supply of purchasable feedstuffs, the improved nutrition must come from forage production.

Livestock systems research

The differences between LSR and FSR are brought about by practical problems in conducting research rather than by differences in intent and scope. The following schematic outline of an integrated research programme drawn up by Harrington (1980) fits as well to LSR as it does to FSR and is a suitable framework on which to hang the particular aspects of LSR discussed in this paper.

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                              ON-FARM RESEARCH

choice of                                                  new components
target                                                     incorporated into
farmers and                                                on-farm research
research      >>>>>>>>>>>>.........<<<<<<<<<<<                  .
priorities        1. Plan
     .                obtain a knowledge
     .                and understanding of
     .                farmer circumstances --F
     .                and problems to plan   .
     .                experiments.           .
     .                                      E
     .            2. Experiment              .
     .                conduct experiments    .
     .                in farmers' fields     E
     .                to formulate improved--.
     .                technologies under     .          .
     .                farmers conditions.    D    EXPERIMENT
     .                                       .    STATION
     .            3. Recommend               .    developing
     .                analyze experimental   B    and screening
POLICY                results in light of    .    new technological
CONTEXT               farmers circumstances--.    components
national goals        to formulate farmer    A    eg. varieties
input supply,         recommendations.       .          .
credit,                                      .          .
markets, etc.     4. Assess                  C          .
     .                determine farmers'     .          .
     .                experience with--------.          .
     .                technologies.          K    identify
     .                                       .    problems
                  5. Promote                 .    for station
                      Demonstrate improved---    research
     <<<<<<<<<<<<<    technologies to farmers.>>>>>
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Fig. 1. *Overview of an integrated research programme.*

Considerations in designing improved technology

Complementarity

LSR should freely use the research results and experiences of other research and development organisations. LSR should also call on these other institutions to carry out back-up work. The research institutes can help overcome problems that require detailed on-station experimentation. That does not, however, preclude LSR teams from doing their own experiments which can not be done elsewhere for, say, ecological or cultural reseaons.

The development agencies are essential to LSR as vehicles for testing the proposed interventions and procedures in the real world. There is no other way for LSR to test the adoptability of its products.

Case example

ILCA's subhumid programme is closely associated with the National Animal Production Research Institue (NAPRI) of Ahmadu Bello University. NAPRI has been conducting research on animal production in Nigeria for about 30 years and has a wealth of results, information and scientific expertise on which ILCA has relied very heavily.

The programme is also linked to the Livestock Project Unit (LPU) of the Federal Livestock Department. The LPU is responsible for implementing a World Bank-assisted livestock development project. The staff of the LPU provide an ever-present audience from the development community which is necessary in the selection of priorities and for the quick uptake of interventions. The association with LPU will enable ILCA to assess the uptake, effectiveness and persistence of its innovations in 'real life'.

An example of this three-way cooperation can be taken from the nutrition trials conducted in the LSR programme.

On station. The rations were developed from data on feed requirements, and forage and agro-industrial by-product nutritional values determined by NAPRI scientists.

Researcher managed trials. Carefully controlled trials confirmed the predictions and the Fulani appeared to accept the principle of feeding certain animals certain amounts at certain times.

Farmer managed trials. The LPU then incorporated ILCA's findings into a pilot smallholder dairy scheme that is now being actively promoted. ILCA is continuing to obtain all the necessary records to assess the uptake, success and persistence of the innovation through its close association with LPU field staff.

Policy oriented

Being complementary also means that FSR must be policy oriented 'with decisions relative to national research goals being fed downwards' (Dillon, 1973). This is essential to the cohesiveness of the above three steps.

Case example

The Director of the Federal Livestock Department, who is also on the Board of ILCA, has appointed a technical advisory committee of distinguished Nigerian agriculturalists to assist the team with advice and guidance on both technical and policy matters. This committee is chaired by the Director of NAPRI and has other members from federal, state and University circles. Their input, both formal and informal, is essential to keeping the team's work consistent with national policy. If the team did not have this advice it not only could lose vital support but it would also be much less likely to come up with adoptable interventions.

Social responsibility

In most basic research the purposes and advantages to the end users are not a major concern of the scientist. LSR, however, has a social responsibility. For example technologies that may aid larger farmers to the disadvantage of smaller farmers should be avoided lest they defeat the prime objective of LSR, which is to conduct research for development that does not exacerbate inequalities. That is not meant to exclude interventions that may help both rich and poor alike or even help rich without any effect on poorer farmers, since production and paid employment are usually within government objectives.

Case example

Despite accusations of being patronising and attempting to keep farmers backward ILCA has assiduously avoided the use of tractors in the preparation of fodder banks because the extent of cultivation is limited by the amount of available family labour, and tractors could drastically alter the *status quo* to the disadvantage of the poor.

Reviewing priority problems and opportunities

Once the objective of the LSR effort has been defined the LSR programmes still need to be carefully focused or else the scientists will tend to take on too much and, as a result, individuals may work hard at appropriate but inadequately co-ordinated tasks. Each discipline must be clear as to the contribution expected of it. If, for example, livestock nutrition is the focus of the programme only those disciplines necessary for resolving the nutritional constraints should be employed. However, this will inevitably require a multi-disciplinary team because the economic and social factors are likely to be as problematic as the agronomic ones.

Case example

As indicated above the subhumid programme has focussed on the alleviation of malnutrition in domestic ruminants with forage agronomy at the hub. The social scientists helped make it possible to grow forages by determining how pastoralists could obtain the right to use and fence fallow land belonging to arable farmers. There are a myriad of other possible examples from all disciplines. For instance, of all the possible diseases the veterinarian first concentrated on internal parasites in young stock because it was reasoned that with sedentarisation and cattle continuously returning to the same spot the worm burden in calves was likely to build up. This is likely to be even more of a problem with the establishment of more or less permanent fodder banks and, if true, will tend to negate the advantages of better feeding.

Later it was argued that the establishment of fodder banks might be more profitable if they were used by more productive animals

such as dairy crosses, but these animals are known to be more prone to diseases. Thus the veterinarian is now studying the disease patterns in a small number of experimental crossbred animals attached to Fulani herds with fodder banks.

Appraising present techniques

This subject is possibly more difficult in livestock research because there is typically even less contact between research stations and pastoralists than with their farming counterparts. However, the LSR scientists should still try and discover all the approaches that have been attempted and how they fared. Then when considering alternative ideas generated from within the team they should go back to the local scientists and extension workers for advice. More often than not there will be good reason why these ideas have not been tried successfully before. Ultimately, however, the interventions will have to be proven in the prevailing ecological and socio-economic environments.

Case example

The subhumid programme took all available advice before commencing trials with undersown legumes but even then the results were somewhat embarrassing; the seeds were washed out of the ridges, drowned in the ridge bottoms, were weeded out in a 'surprise' third weeding and so on. Ultimately it was found that the time of undersowing relative to the planting of the main crop is very critical. If this is done too early the crop is damaged if too late the yield of stylosanthes is also supressed.

Similarly when crossbreds were first introduced they were not tame enough for the traditional manual de-ticking and they contracted a range of diseases not prevalent in local Fulani cattle but which are endemic to the area. Appropriate chemo-imunisation and acracide spraying regimes had to be instituted.

Setting assumptions about near-term conditions

The team must take into account not only the present circumstances but both recent past and immediate future trends. If it does not it is likely that it will test interventions that will no longer be relevant by the time they are proven.

Case example

The subhumid programme is aware of the trend towards increased areas under cultivation and increased stock numbers. Both these factors weaken the relative bargaining position of the pastoralists. There will be more competition between them for less grazing. In these circumstances it would be unwise to concentrate wholly on forage production and the team is devoting considerable resources towards crop-livestock interactions. This involves research into crop residue production, storage and utilisation as well as growing food crops in fodder banks by judicious rotation or by transplanting into rows hoe-cut through the stylo.

Testing improved technology

The testing of improved technology is difficult to write up in the form of an overview because so many of the details vary according to the particular techniques employed by the different disciplines. For instance the veterinarian will use quite different methods from the agronomist. This section will, therefore, concentrate on discussing problems of technology testing for improving livestock production. The normal sequence used in explaining the phases of FSR work is from researcher managed, researcher executed, through research managed, farmer executed, to farmer managed, farmer executed trials. In effect this means that the scientists first conduct their own experiments to prove and explain scientifically how the technology actually works. Then they run the experiment with the farmers' participation to see if farmers have the technological resources to cope with the innovation and that it can work in their circumstances. Finally the researcher takes a back seat and observes whether or not the farmers actually adopt the innovation. If ultimately the farmers do not adopt the innovation, or only with drastic alterations, the innovation must be dropped or returned to the drawing board for further adaptation.

In pratice this is a somewhat simplified scheme of things because there is constant feedback at all stages. Whenever problems arise the whole or part of the trial can be returned to an earlier phase or occasionally leap-frogged forward. Generally speaking the earlier the phase the greater the control and detail and the more

certain the science. The later the phase the greater the influence of the 'real world' and the greater the assurance of relevance to the system in question.

This tidy format is by no means automatic. For instance the unwary scientist can very easily enter a farmer managed, researcher executed phase when the farmers apply their considerable ethnoscience in dealing with intruders with the objective of getting all they can out of the researchers without any real commitment to the researchers' objectives.

Researcher managed, researcher executed trials

When innovations are too uncertain and risky to try on farmers' fields or they require examination under strictly controlled conditions they should be tested in fields and herds wholly controlled by scientists. These trials are usually carried out at national research institutes or on sites controlled by the LSR teams in their case study areas. The research at the national research centres will usually have been done in the past and not specially for the LSR programme. Great care must, therefore, be taken in extrapolating the results. The difference between the circumstances of the original research and of LSR must be identified and their effects determined. Occasionally they will have to be repeated in the case study area.

Case example

NAPRI had considerable data on the productivity of Bunaji (White Fulani) cattle. In view of the long generation inverval it was extremely valuable to the team to find the data already existent. However the data had been gathered from government livestock improvement and breeding centres and not from traditional pastoralists' herds. It provided potential production parameters rather than baseline data.

NAPRI also had data on natural forage quality but it related to the semi-arid border of the subhumid zone. The extrapolations have to be validated with local data. NAPRI has data on legume cultivation and Friesian-Bunaji crossbred productivity but both were supported by mechanised farming which is not replicable in pastoral livestock situations.

Researcher managed, farmer executed trials

Once the LSR team has designed an intervention and completed successful on-station trials it can set an hypothesis that it will be beneficial for livestock production in the selected district or region. The next phase in the LSR cycle is to let the pastoralists try out the intervention under the guidance of the LSR team: researcher managed, farmer executed.

Sample size

This is where LSR starts to diverge most sharply from normal research station experimentation. It is the point where data collection becomes extremely problematic because of the mobility of the stock, their large unit sizes and the owners' emotional involvement with their animals. Moreover, because of the long generation intervals it is absolutely essential that records are kept of the same animals for a number of years. The sample size has, therefore, to be large enough to cope with losses and drop-outs over a long period.

Sample size is also determined by the need to have enough farmers involved to eliminate effects of differences between individual farmers. The effect of individual abilities, ambitions and circumstances is likely to be stronger on livestock production than on crop production because of the daily need for decisions over the herd and the competition between herders for favourable grazing. At the same time LSR can easily become too unwieldy and costly. For instance a sample of only 20 herds may involve over 1 000 animals. Sampling is also constrained by the need to work with pastoralists who are willing to cooperate almost on a first come, first served basis. There are too few herds within serviceable areas and too much communication between pastoralists for the team to pick and choose between them.

The subhumid programme was able to get over these conflicting demands in the early researcher managed phase by keeping control animals in every herd. For instance only half the eligible animals from any one herd would be included in any trial. The owners were amenable to this because they preferred to have half the animals better off rather than none at all. This technique could not,

however, be continued into later trials because once the farmers saw the benefits, there was no way of preventing them employing the innovation on the control animals at their own expense.

The question of cost effectiveness is dealt with below. As for unwieldiness, it is true that all the catalysts for Murphy's Law (remoteness, poor communications, almost illiterate enumerators and huge amounts of data) are present in force. If it can go wrong it surely will. This can, however, be considerably alleviated by integrating the LSR programme so that, as far as possible, a single pool of data is used. This optimises the use of available staff since, for example, a calf is only weighed once, be it for the breeder, feeder, vet, economist or whoever else needs calf weight data. It also means that the various disciplines have to bargain with each other and justify their use of resources in terms of the team's overall objectives. The sample size is then determined by the purposes of the survey.

Household economic studies are perhaps the most contentious. Some economists argue for large random samples in order to achieve statistical reliability but there appears to be a growing school of thought, very evident in the criticism of earlier drafts of this paper, that, in view of all the problem in supervising enumerators and processing data in field programmes, small select samples may be preferable. Innovations will only be adopted by herd owners if they have marked effects on their welfare so it should be sufficient to just know the major items of income, expenditure and time budgets of a small representative selection of the various categories of producers in the target population. Another advantage of the small sample is that it can be done at the same time as the in-depth study of household decision making processes that is an essential part of most LSR studies.

Frequency of data collection

The frequency of data collection is perhaps most contentious in this phase of the LSR cycle. In the previous researcher managed phase the fact that the researchers are 'in charge' allows for smaller sample size and greater reliability and fewer hidden factors. In the

next phase of farmer managed- farmer executed trials the technical possibilities have already been determined and explained. The LSR team is by then more concerned in determining to what degree the farmers can cope with the innovations and what benefits they obtain from following the recommendations.

In the researcher managed, farmer executed phase scientific technical understanding and explanation is still required but the researcher must allow for the farmer's independence. That means the frequency of recording must take into account such factors as the farmers' natural reluctance to reveal sensitive information such as sales prices. The farmers also have, deliberately and unavoidably, very variable powers of memory recall. The more sensitive the topic or the more aware the farmer is of the official, correct or expected answer the less accurate his memory. To combat these factors it is often better to observe the event rather than to ask about it. Some degree of apparent over-kill in data collection may be necessary. For instance since sales, purchases, deaths, births, slaughters and losses can occur on any day it is probably as well to have an enumerator visit the herd daily. To avoid irritation at his presence and because firm routines are essential to the management of staff who are not expected to fully understand the reason or importance of diligence, it may be as well for the enumerators to record milk offtake daily. This gives them defendable purposes to be in the herd whilst recording all the other activities.

Case example

The subhumid programme adopted all the above principles reasonably effectively. Local school children were employed as enumerators to record milk offtake, deaths, sales etc. on a daily basis. However, difficulties did arise in data processing because the team had no in-house computer and attempted to run all its data once a year on the central computer at head office. This meant that the scientists had the greatest difficulty in ensuring adequate supervision. Nor did they have any way of doing preliminary or interim analysis to test the reliability or suitability of the data. When finally processing the data the remoteness of the computer meant that they had no access to original records even for simple items like checking

eartag numbers. These problems led ultimately to an inefficient use of computer and staff time. There is little doubt that systems research teams ought to have their own micro-computer facilities from the outset.

Duration of data collection

There can not be any hard fast rule about the duration of data collection except that data collection should always be for a purpose and once that purpose has been accomplished the data collection should stop.

Case example. The subhumid programme found it necessary to study the grazing behaviour of pastoral herds as a means of determining the type and quantity of feed available to the cattle throughout the year. This was intended as a one year study but the extent of burning and time spent on burn-regrowth had not been anticipated and was only appreciated after regrowth had been a significant part of the diet for a few weeks. The study had, therefore, to be continued for a second year.

The basic herd productivity recording started at the outset of the programme yet it is still continuing because after three years there are too few data on calving intervals and age at first calving. More time is, therefore, needed for the team to acquire data on such basic parameters as age and weight at first calving in traditionally managed herds, let alone what effect improved nutrition may have on those parameters.

Farmer managed, farmer executed trials

Once farmers have successfully executed the procedures, or implemented the interventions under LSR guidance, and the indications are that they are happy with the design and wish to adopt it as part of their normal husbandry practices, then the trials can move into the final phase of the LSR cycle. The LSR team members must then stand back and become passive observers so that they can test whether their brainchild can survive without them. The team needs to know if the intervention is adopted at all and at what rate (i.e. what is its acceptability index), how closely the farmers adhere to the original

design, what modifications they introduce, how successful the intervention is in terms of the goals it was designed to achieve, how persistent it is and what side effects it has.

This phase of the cycle can only be accomplished in cooperation with the extension and development agencies. It cannot be done very convincingly by the team trying to simulate extension officers. They can not be that uncommitted to their own concept. It is essential, therefore, that the team develop a sufficiently close relationship with an agency that will allow them access to the necessary data both of extension inputs and from the participating farmers.

The frequency of data collection can be very much less than in earlier phases because it is no longer necessary to try and explain what is happening at a micro-level. It is the macro-effect on farm output and profitability that is important. The duration of the experiment should be at least five to seven years in trials involving large ruminants such as cattle but may be less for smaller species with shorter generation intervals.

Case example

The cordial relationship ILCA has with the Federal Livestock Department and the Kaduna State Ministry of Animal and Forest Resources provides ideal facilities for this phase of the LSR cycle. Indeed the only problem is that some innovations are being adopted before ILCA would normally be ready to move on from the researcher managed phase.

By working through the livestock service centres ILCA hopes in 1984 to have, in effect, a network of testing sites spread throughout the zone in Nigeria. These will provide ideal conditions because they will be created under differing circumstances and well away from the present sites in Kaduna State where ILCA's own influence cannot be eliminated.

Applicability of LSR to national authorities

The advantage of the international teams, which must always include a number of nationals and have close links with local institutions, is that there can always be injections of fresh ideas and cross ferti-

lization from innumerable sources. There is no way, however, that the tiny teams from international agricultural research centres (IARC's) such as ILCA can do much more than scratch the surface of the problems of livestock production, though they may help significantly in developing new research methodologies, and in assisting the establishment of national LSR teams and possibly in setting goals and standards for LSR.

National LSR teams should be established at all the major research stations where they would help orientate their research programmes towards existing field problems and speed the transference of research results to the producers. The teams may be comprised of scientists wholly engaged in LSR or it may form just part of research scientists' duties. CIMMYT tried attaching one FSR economist per research station to lead the FSR work and encourage the participation of other scientists. It was hoped that this would improve the problem solving relevance of the work of the stations. However, this was not effective as it might have been because not all the resident scientists had been persuaded of the advantages to them of FSR.

Case example

Having actively encouraged the ILCA subhumid programme for a number of years NAPRI is now setting up its own LSR team that will be able to capitalise on ILCA's experience and move into different ecological zones. It will be able to focus more directly on Nigerian problems and with access to the substantial research capability at NAPRI and other departments of Ahmadu Bello University it is potentially a very effective unit.

Cost effectiveness

LSR has the immediate appeal of not requiring the massive investments in land, buildings, stock or equipment that is necessary for establishing a research station. LSR is also adept at exploiting past on-station research without further cost. LSR also has the advantage that, with an appropriate inclusion of rapid 'down-stream' elements, there is an almost immediate response in productivity. In other words the benefit stream can be turned on certainly earlier than from on-

station research and even earlier than from most development projects that tend to concentrate on infra-structural developments in the first years.

Nevertheless, the outline of the problems connected with livestock systems given above gives plenty of scope for very expensive research. If each discipline expects to work with the same support it would command in specialised research departments the costs of LSR would be quite unreasonable. However, provided that those problems that require very detailed research with, for example, expensive laboratory equipment are referred to the appropriate institutions and the LSR scientists are prepared to adhere to the goals of the LSR programme and make the necessary compromises, LSR is not overly expensive. In the ILCA subhumid programme it is estimated that it will require only 120 herd-owners to adopt the proposed packages in order to justify US $ 1 m of research. With a recommendation domain of several hundred thousand livestock owners it should not be difficult to defend the expenditure on LSR in social cost benefit terms provided that the innovations really do catch on.

It is of course very rewarding when, as with the fodder banks, producers in the vicinity of the LSR adopt the innovations for themselves. It is also encouraging when pastoral organisations such as the Myetti Allah Cattle Fulani Society follow the LSR and spread the word. These actions will go a long way to justify the expenditure on LSR but, especially for an IARC like ILCA, the prime clients for the research results must be the extension and development agencies in the host countries across the zone. It is their function to take the innovations to the producers. If the LSR programmes can improve the rate of return on the investments in development and extension schemes there will be no question of the cost effectiveness of LSR.

Apart from the obvious need for thorough technical accounts of the success and failures of interventions under test, the extension workers require critical reviews of the circumstances and the back-up support necessary to the success of the innovation. With this addition the recommendations will be very much more useful than the jargon-loaded reports in scientific journals or the limited instructions presented in typical appraisal reports.

Case example

The LPU Smallholder Dairy Scheme grew out of the ILCA nutrition trials where the Fulani had demonstrated that, with adequate guidance and assurance of supplies, they would selectively ration their cows. By doing so they improved the returns to the scarce resource of purchasable feedstuffs. ILCA did not just hand over reports on the trials but worked closely with the LPU staff in the design of a Livestock Service Centre which could deliver the necessary advice, credit and material provisions necessary to the success of the scheme. The pilot Livestock Service Centre and its successors will serve as vehicles for the dissemination of future proven innovations and research findings as well. This will hopefully ensure that:

1. the producers get the proper advice;

2. the producers can obtain the necessary inputs as and when they require them;

3. ILCA will have access to the records and the contact with the producers that it needs to determine the uptake, adoptability and persistence of its innovations in the final farmer managed, farmer executed phase of the LSR cycle. This is particularly important in range livestock work because, as noted above, there is tendency for innovations to be picked up before they are proven. Thus it is essential that a watchful eye be kept on them so that faults can be detected quickly and timely corrective action taken.

Extension into development projects

As indicated earlier LSR can help bridge the gap between research institutions and development projects firstly by establishing that the innovations are acceptable to the producers and then by carefully detailing when, where and how best to encourage the uptake of the innovations. For instance, varieties, planting dates, seed and fertiliser rates etc. are only part of what an extension officer needs to know in order to encourage farmers to produce forages. He also needs to know which category of farmer is most likely to respond, which arguments are most effective in eliciting the response of the farmer (i.e. those that are most closely allied to the needs and

interests of the farmer) and what back-up services the farmer will require. The planners and decision-makers would also like to have some idea about the likely rate of up-take, the optimum extension officer to farmer ratios, the availability of inputs and the marketability of the increased production. Obviously LSR can not provide such a service to each and every project but a thorough analysis of these factors in the process of conducting the trials will be of immense benefit to those carrying out feasibility studies in other areas. Instead of using blind hunches, project preparation teams can look for similarities and variances and assess the consequences of those factors that have been shown to be important to the success of the innovations.

Naturally the closer the link between the LSR teams and development project staff the smoother will be the transference of innovations from research to development. This will apply to all development projects, not just the ones physically associated with the research, because of the establishment of an empathy with the problems of development. As indicated above this can best be promoted by cooperation at the farmer managed, farmer executed phase of LSR.

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