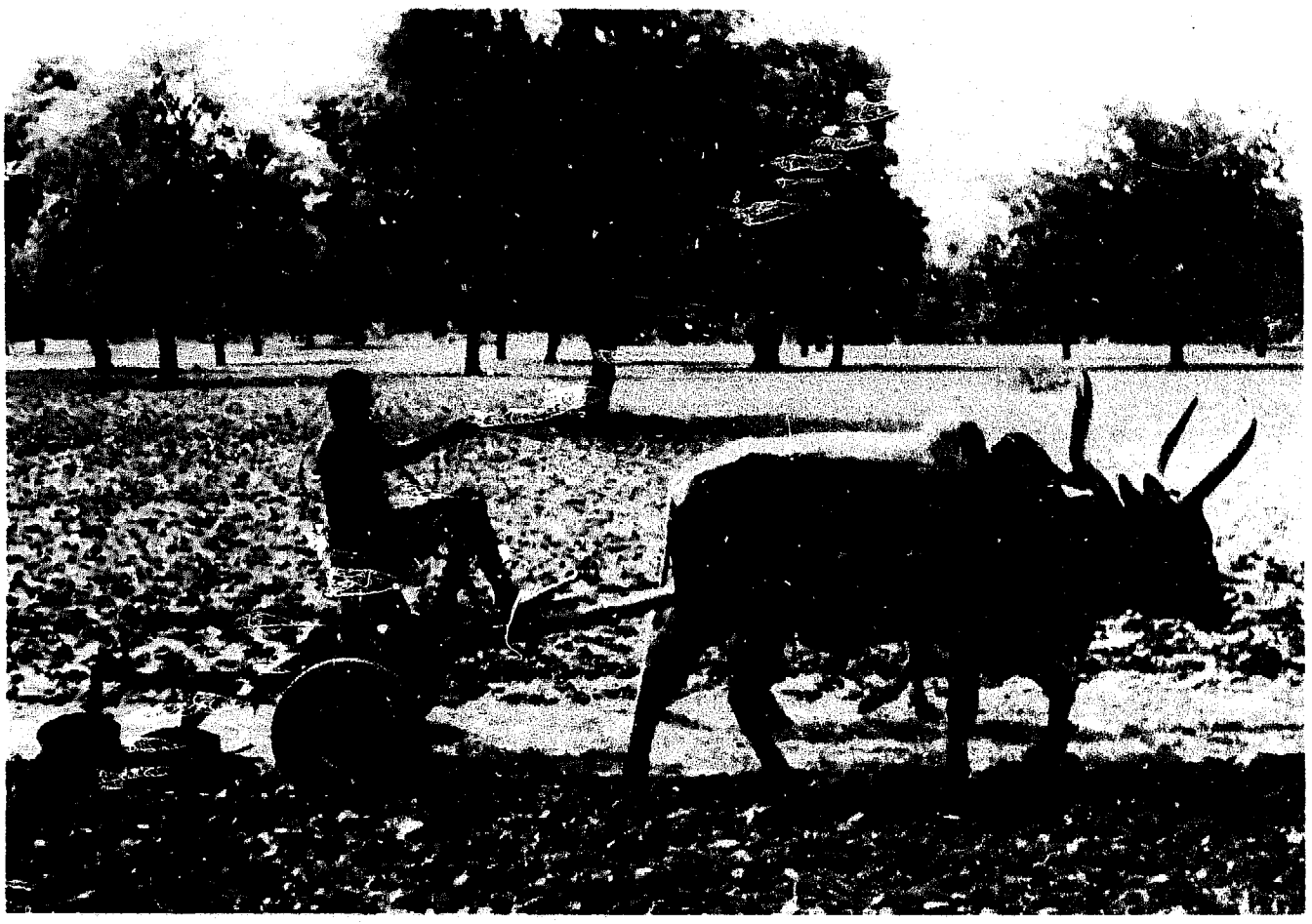
Paul Starkey

Animal-Drawn Wheeled Toolcarriers:

Perfected yet Rejected

Aus der Arbeit von GTZ



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8. Implications, Lessons and Conclusions

8.1 Summary of experiences

The review of wheeled toolcarrier projects over the past thirty years reveals the following points in common:

– All initiatives have been characterized by much early enthusiasm for the design.

– All designs have been subsequently modified and refined.

– All modified designs have been proven capable of work on station.

– Designs with a high degree of versatility have been found complex by farmers and expensive and/or difficult to manufacture accurately, and there has been a tendency to simplify designs with time.

– All designs have been described by farmers as being heavy for the animals to pull, and they had therefore been used with fewer than expected implements, or with multiple pairs of animals.

– Despite the potential for conversion from toolcarrier to cart, farmers have generally kept to one mode, and after one to three seasons as a cultivation implement, almost all toolcarriers have been used only as carts.

– Despite optimistic forecasts based on on-station use, it has never been shown that farmers themselves have found that the benefits of toolcarriers justify their high costs.

– No wheeled toolcarrier has yet been proven by sustained farmer adoption in any developing country.

About 10000 wheeled toolcarriers have been made, but few of these were paid for at a realistic price by farmers. The number of toolcarriers of any design that have ever remained in use by farmers as multipurpose implements for at least five years is *negligible*. Research, development and promotional activities are now continuing in at least twenty countries in Africa, Asia and Latin America. Most on-going activities have been started because the national programmes or aid agencies believed that wheeled toolcarrier technology had succeeded somewhere else. To date it has not succeeded and there seems little evidence to justify any optimism for the technology. Prospects for present programmes in Africa and Asia seem very bleak and in general the outlook for wheeled toolcarriers is *not bright.*

8.2 Implications of research methodology

8.2.1 Overall approach

The methodology of almost all toolcarrier research programmes reviewed has been similar, being based on the development of high quality (high cost) solutions proven competent under optimum on-station conditions. For example ICRISAT researchers have described their own approach as follows:

"The path which the Vertisol technology development at ICRISAT has followed is essentially one which from component research to package and system design remained within the research station in Patancheru and then entered into farmers' fields, with the effect that many constraints were understood only at the stage where farmers were confronted with the technology." (von Oppen et al., 1985).

The results of the programmes have also been similar. For example Ahmed and Kinsey in a review of farm equipment in eastern and central southern Africa stated:

"A common finding is the inappropriateness – on the grounds of multiple criteria – of many products produced by farm equipment research and development. It is interesting, for example, that the animal-drawn toolbar, which is reported to be widely used in West Africa, has not been accepted by farmers anywhere in eastern Africa. Yet research and development on toolbars date back some 20 years in the case of Uganda, and a decade or more in other countries. Either adaptive research has failed in this instance, or promotional efforts have been ineffective or aimed at the wrong farming systems." (Ahmed and Kinsey, 1984)

Promotional effort has seldom seemed lacking, but what has often been missing has been a detailed knowledge and sympathetic understanding of the prevailing farming systems. Researchers have seldom ascertained farmer reaction to previous schemes, they have often had a top-down approach, and have tended to work on implements designed for technical excellence in on-station conditions far removed from local realities. It is now clear that all the programmes reviewed would have benefited from much more contact with farmers at all stages.

8.2.2 Analyses of previous experiences

The majority of wheeled toolcarrier programmes have been based on enthusiasm for the relatively new toolcarrier concept and the researchers' own innovative design features. Comprehensive literature reviews have been very few but, as already discussed, simple literature searches would have revealed mainly optimistic reports. There seems to have been very few attempts to understand the actual field experiences of previous initiatives.

It is instructive to see how the international research centre ICRISAT approached the issue of analysis of experience. From its early stages it tried to maintain a global vision by testing wheeled toolcarrier designs from several countries and collaborating with acknowledged experts in the technology from France and Britain. It also gradually assembled documents and reports from several (Anglophone) countries and a review of these was published eight years after the start of the programme (Bansal and Thierstein, 1982). Clearly some genuine attempts were made to analyse previous experience, but (with the expertise of hindsight) the methodology could have been improved.

Firstly, as is normal in any programme, the external collaborators were those already associated with promoting the technology. In the early stages of technology identification, it may also be valuable to seek the advice of those without vested interests but with practical experience of working with smallholder farmers – perhaps those in extension rather than research and preferably the farmers themselves. One effective way of doing this is through field visits and discussions with both farmers and extension workers, and another is through multidisciplinary "networking" meetings involving not just agricultural engineers but extension personnel and research scientists. Secondly, while analysis of experience should be ongoing, a good understanding of previous lessons should be achieved *before* a programme is so committed that changes in direction are difficult. From the various case histories reviewed in previous chapters it is clear that in many instances a few weeks or months of letter-writing and reading reports to establish previous lessons could have saved not only money but many months or years of unproductive work.

Thus future research initiatives should start with a detailed analysis of existing experiences, with information obtained not just from

publications but from farmers themselves or those closely in touch with the farmers. Such analyses, combined with a knowledge of the target systems, should lead to precise definitions of the required task and the available resources that are necessary to ensure that equipment will be appropriate.

8.2.3 Domineering (top-down) approaches

Very many of the programmes reviewed have been based on the principle that: "*you* have an inefficient system of agriculture; *we* know the answers". Equipment has been designed and built in France, Britain and Canada and flown out to research stations in developing countries. On research stations staff have tried to develop technologies that will make peasant farmers toolbar-minded and so prepare them for the ascent of notional mechanical ladders leading quite rapidly to four-wheel tractors. There has been little attempt to understand the realities of the farming systems and the ways in which existing practices may be highly efficient in their environmental context.

Colonial domineering approaches in the late 1950s and early 1960s might be explained (some would say justified) by the prevailing social attitudes of that era. However, unfortunately this is not merely an historical problem, for this "top-down" attitude pervades many modern programmes. As recently as 1986, a wheeled toolcarrier programme was justified as a means of proving that equipment appropriate to the needs of the African farmer could be cheaply and efficiently designed in Canada. Not surprisingly it totally failed to demonstrate this.

The problem is not only one of expatriates being patronizing to Third World nationals, for the attitude that researchers and extension workers know best can probably also be found within every national programme. For example a booklet for extension workers describing the use of work oxen, single purpose plows and wheeled toolcarriers starts with the sentence, "The average Ugandan farmer has a small farm; he has a low income, and little farm knowledge know-how". (Akou, 1975). Similar phrases occur throughout the world. Some are merely shorthand for saying that farmers are unfamiliar with modern industrialized agricultural technology, but some imply that the farmers have insufficient knowledge and understanding of their own farming systems. As has been apparent in this review and many other studies, the "failures" of research and extension programmes are generally due to the professionals themselves not understanding the farming systems, and trying to impose on them technology that the farmers consider inappropriate.

It should now be clear that research and development programmes should start with a humble approach and an understanding of local farming systems derived from discussions with farmers. Programmes should work closely with the farmers and jointly identify and evaluate methods of improving farm productivity and incomes.

8.2.4 Pursuit of technical excellence

In most of the case histories reviewed, attempts have been made to develop high quality implements, and thereby high cost solutions to problems. The objectives have been laudable – to produce high incomes for farmers. However this pursuit of technical excellence and high-input, high-output farming systems has not been proven appropriate. Farmers require technology that is effective and affordable, which can be maintained in their villages and which provides reasonable convenience at an acceptable risk. Wheeled toolcarriers though often technically effective have not been shown to pro-

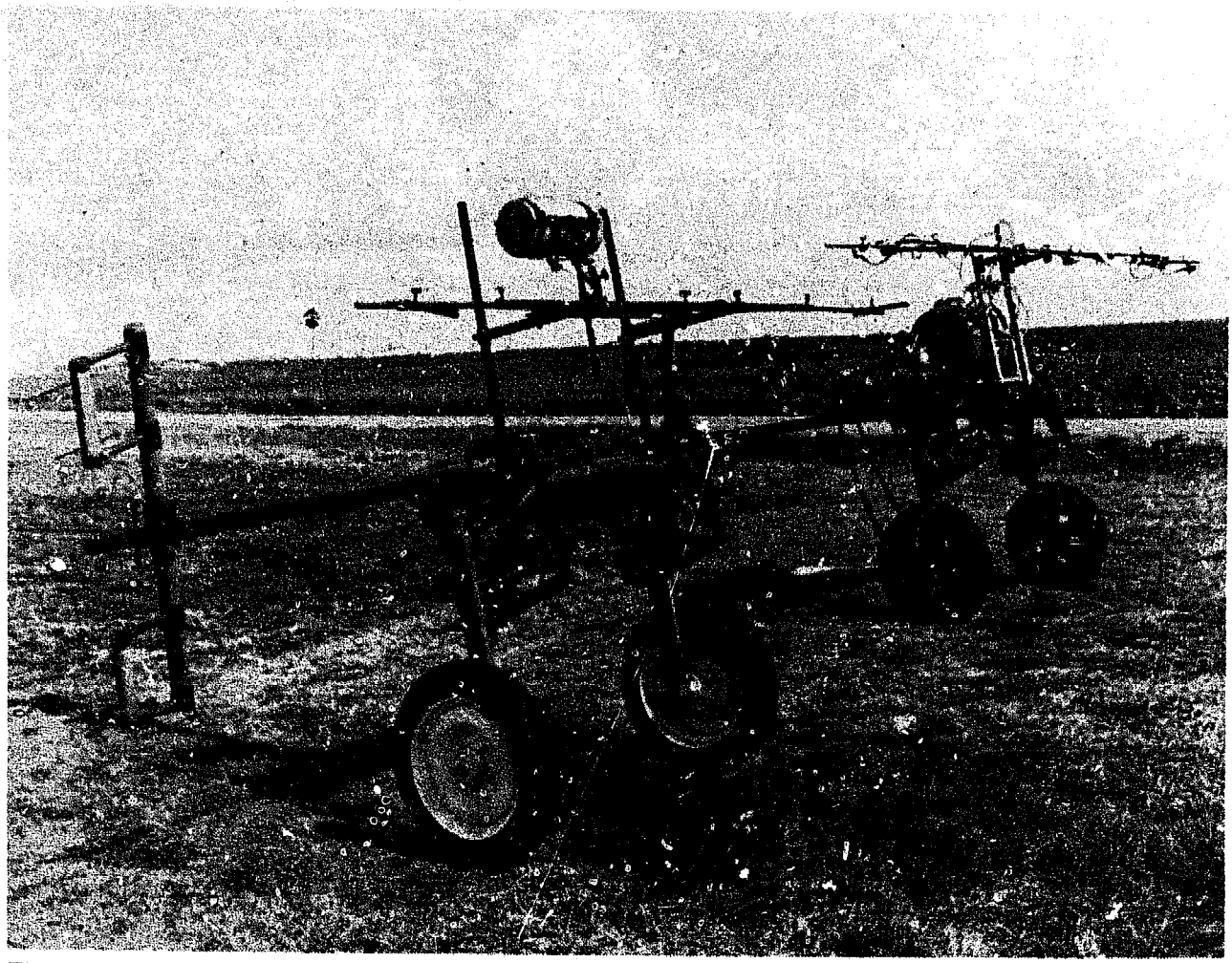
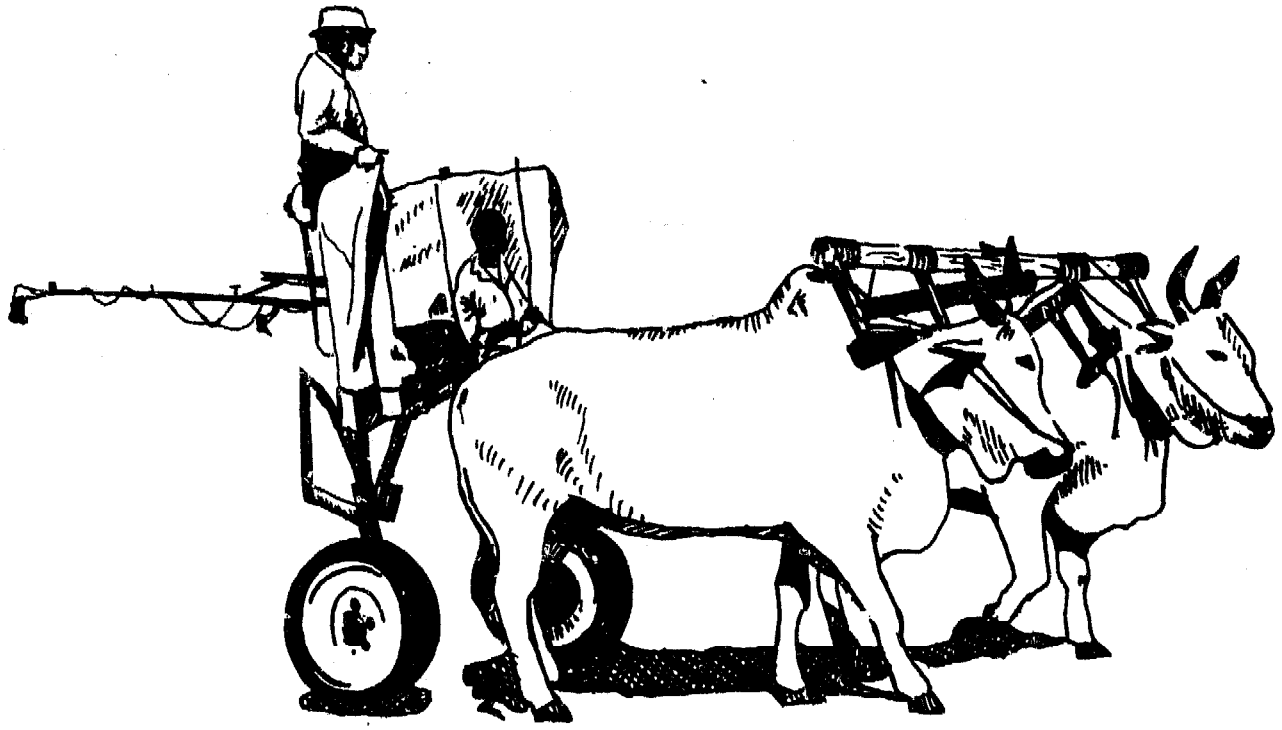


Fig. 8-1: Pesticide sprayers for pigeon peas developed at ICRISAT Centre (note raised Tropicultor chassis and raised yoke). (Top photo: P.H. Starkey; drawing from ICRISAT photo).



vide this combination, whereas some more simple implements have. The more simple implements may not have led to dramatic improvements in production or farmers' incomes, but they have been sustainable.

The lesson appears to be that technology that is intrinsically excellent may not be appropriate. This is not just an observation on wheeled toolcarriers for in other fields of agriculture there are close parallels. Exotic or crossbred cattle may seem ideal draft animals, but farmers require animals that can be conveniently maintained under village conditions, without too great an investment or risk. In most cases this means that adaptability and affordability are more important than genetic excellence. Similarly high yielding crop varieties that need high levels of inputs have often been judged by farmers to be inferior, in the prevailing circumstances, to lower yielding but well-adapted varieties. This does not mean that technical excellence is not important, but that it should be developed in such a way that it is appropriate to the prevailing environment.

8.2.5 The lack of realism of on-station research

Almost all the programmes reviewed have started as research station studies. This is quite normal. However it appears that few, if any, of the studies were replicated on farmers' fields at an early stage. As a result equipment and cultivation systems were designed and tested in highly unrealistic conditions. The draft animals maintained on research stations are often one-and-a-half to two times the weight of village animals. As a result operations easily performed with two animals on station have been considered excessive for pairs of animals owned by farmers. There have also been examples of research stations using tractors as surrogate oxen in testing wheeled toolcarriers. Research station fields have been cultivated for long periods and are generally relatively smooth and free of obstructions. Meanwhile outside the perimeter fences farmers' fields are often irregular in shape, uneven in surface and contain trees, stumps or roots that have to be avoided. On research stations fields are close and access is easy, while farmers may have to travel considerable distances, often negotiationg slopes, valleys or water courses, to reach their fields. Simple repairs such as minor welding and punctures that are quick and routine on station can cause a smallholder farmer to lose hours or even days. Research programmes ensure adequate labour is available for operations at the optimal time, but in villages there may be more urgent matters that are integral to the farming systems and which have to take priority. On research station seeds are often graded and regular and so ideal for mechanized seeding, whereas in villages seeds may be variable in type and quality and of mixed sizes. Sites for research stations have often been selected for their good soils, reliable rainfall and easy access to water and main roads, whereas the reality of most villages is very different.

In *all* the cases reviewed wheeled toolcarriers worked well on the research stations, yet in *none* of the cases did wheeled toolcarriers work sufficiently well under normal village conditions for farmers to continue using them.

In all countries there are innovative farmers willing to try out equipment if they perceive it might be useful (and if they do not, that is itself a valuable lesson). Researchers should work with such farmers from the very first year of trials, so that even if trials are mainly based on station, there are replicates carried out by farmers themselves. (Compensation arrangements in case of failures can usually be negotiated easily.) While cooperation with farmers close to a research station may be convenient, it is ex-

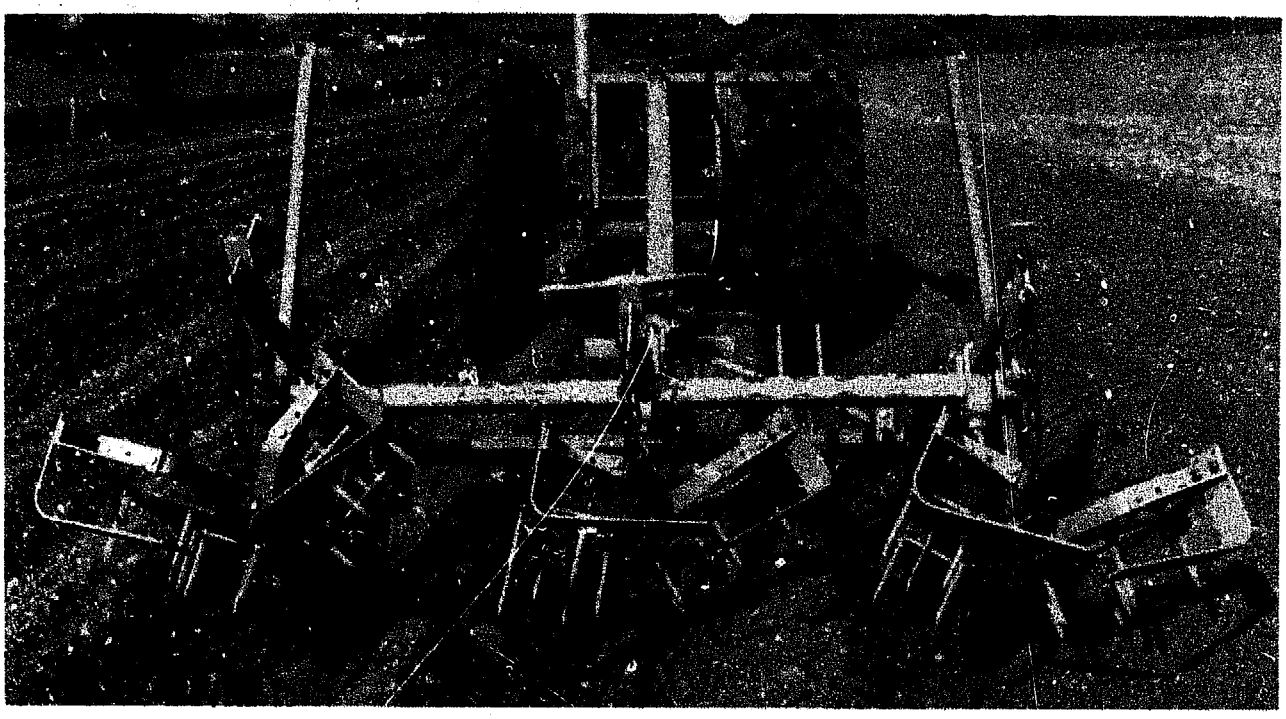


Fig. 8-2: On-station development: prototype weeding harrows on NIAE toolcarrier being tested using a tractor in the U.K., 1967. (Photo: AFRC-Engineering archives).

tremely salutary to try to maintain prototypes in working order in isolated villages. Having gained farmer cooperation, it is essential to ask the advice of such end-users at all stages of research and development from appraisal to evaluation.

Ideally work should continue with several farmers over several years. It is most important to resist the temptation of many researchers to reject on-farm experience in any given year as "atypical". Almost by definition, no cooperating farmer will be typical yet their experiences must be evaluated. Indeed there is no such thing as a typical farmer nor even an average year. Events described in research reports as "atypical" such as dry years and wet years, droughts and floods, pest damage and losses of animals and even social upheaval are actually representative of the realities of rural life. Calamitous events have to be survived by the farmers. Thus, while it may be unrealistic for innovations to be adapted to the worst catastrophes, they certainly should not be designed only for "above average" years.

8.2.6 Interdisciplinary feedback and farmer involvement

The many models of wheeled toolcarriers have naturally been designed by agricultural engineers. Frequently individual professional disciplines remain isolated, and there have been numerous examples from all over the world of agricultural engineers working alone as they develop equipment (or re-invent the wheel). In the case of wheeled toolcarriers, while some prototypes have been built by agricultural engineers working alone, some of the major programmes have been the responsibility of broadly based teams, involving agronomists and social scientists as well as engineers. Thus the Botswana research was in the context of a farming systems programme, and the important ICRISAT involvement was the responsibility of the multidisciplinary Farming Systems Research Program.

The common and generally justified criticism of inappropriate single disciplinary studies is not valid in the context of wheeled

toolcarrier development. Indeed it may well be argued that the close involvement of economists was positively disadvantageous. In all cases economists managed to produce economic justification for wheeled toolcarriers, and this justification was probably the major reason why many of the wheeled toolcarrier programmes in Africa, Asia and Latin America continued with such single-mindedness even after negative farmer feedback was apparent. In the circumstances it seems rather hollow to talk about a need for closer interdisciplinary collaboration at all stages.

Something clearly must have been missing to allow so much time to be devoted to developing and refining equipment that the farmers found inappropriate. The repeated theme that is emerging is that there was no representative of the *farmers* in the teams. Historically much of the agricultural equipment developments have arisen from the innovative ideas of farmers, often working closely with village blacksmiths or local equipment workshops. Innovations have developed from specific problems and attempts to find suitable solutions.

While farmers in developing countries are constantly being innovative and carrying out research themselves (Richards, 1985), their rate of progress is considered too slow for modern governments. Resources are allocated to speed up development. Most programmes, instead of trying to accelerate existing innovative processes, have tried to impose solutions developed in different circumstances. The economists' models of profitability would not have lasted long in discussion with highly practical but resource-poor farmers who unfortunately cannot simply remove problems by assumptions.

It seems evident that multidisciplinary teams must include farmers' realism somehow. Farmers are likely to give the most valuable information in their own environments, among their own peers. It seems essential that research programmes should regularly discuss farmers' problems, ideas and reactions while visiting their villages and fields. Farmers should be given the respect, honour and attention generally reserved for external consultants.

The repeated reference to farmer involvement should not be taken as a quick panacea, but as part of a long-term methodology. The author remembers with humility farm visits in Mali in 1986. One farmer was clearly happy to be testing a wheeled toolcarrier and was delighted with the associated prestige and international visitors. Like many farmers he was not prepared to be damning and dismiss the technology lightly, and indeed he tried to be as encouraging as possible, yet it was apparent from discussion and from the reports of the researchers that the Nikart under test was inappropriate to the local situation. However while it seemed easy for the external people to dismiss the toolcarrier there appeared to be no easy alternative solutions to suggest that would allow the innovative farmers at least some hope of raising their standards of living. The farming systems team was working closely with villagers, but the seemingly valuable combination of farmers, research team and consultant found it much easier to cite problems than devise solutions.

8.2.7 Methodological principles for future farm equipment research

From the lessons of the wheeled toolcarrier research it is clear that future animal traction or farm equipment research should be:

– carried out with much more involvement with farmers who might usefully be regarded as "consultants" in problem identification, definition of requirements and very early evaluation of prototypes,

– based on a clearly defined need derived from a knowledge of local farming systems and socio-economic conditions,

– based on studies of actual field experience of previous initiatives.

At the international networkshop "Animal Power in Farming Systems" held in Sierra Leone in September 1986 (Starkey and Ndiamé, 1988) a group discussed the stages required for effective farm equipment development. An edited version of the group's proposed methodological steps is as follows:

1. Identification of needs: study of the farming system in which equipment will be used, and context of work for which it will be selected or developed.

2. Operational requirements: definition of exactly what the equipment is required to do.

3. Specifications: clear listing of weight, draft, size, working width (requirements, limits), affordable costs, technical level of users, maintenance requirements, working life.

4. Study of options: review of available equipment (locally or from other countries) that meet specified requirements.

5. Selection of design. If none available development of new prototype or adaptation of existing equipment.

6. On-station testing and evaluation of selected design.

7. On-farm testing and evaluation with farmers.

8. Standardization of appropriate design, with formal drawings.

9. Small batch production and distribution to farmers.

10. Further on-farm evaluation with farmers to establish durability and suitability.

11. Economic studies and assessment.

12. Large-scale production and extension.

This list should not be taken as definitive (for example socio-economic determinants such as risk have not been cited and economic evaluation should be considered a more continuous process) but it is helpful for identifying a desirable methodological sequence. Stages 1 to 3 (identification, definition, specification) will be highly area-specific and require close work with farmers. Stage 4 (review) is most important to prevent the unnecessary repetition of research. However, most of the programmes reviewed here have tended to start immediately at stage 5 with prototype development. They have then spent time at stage 6 (on-station testing) before jumping quite rapidly to stages 9 and 12 (batch production, large-scale production and extension). Steps 10 and 11 (detailed on-farm evaluation and economic evaluation) have generally been neglected.

This list quoted was produced at the "Animal Power in Farming Systems" networkshop with equipment development in mind, but many of the methodological stages are comparable with those in other fields of development. To conclude this section and at the same time to broaden its scope, the summary of another of the discussion groups at the same networkshop appears highly relevant to this review. Charged with deliberating the subject of animal traction research methodology, the group agreed that a multidisciplinary and farming systems approach was important and that more emphasis should be placed on social and economic issues than has been common in the past. To prevent technically excellent but inappropriate techniques being developed from the very first year of research programmes there should be replicates of any on-station trials or development work on some farmers' own fields. Finally farmers should be closely involved in planning and evaluation at all stages of a research programme.

8.3 Single or multipurpose equipment

Multipurpose equipment inevitably involves compromises in design and generally means that multipurpose equipment is technically inferior to a range of single purpose implements. In general it is more convenient to

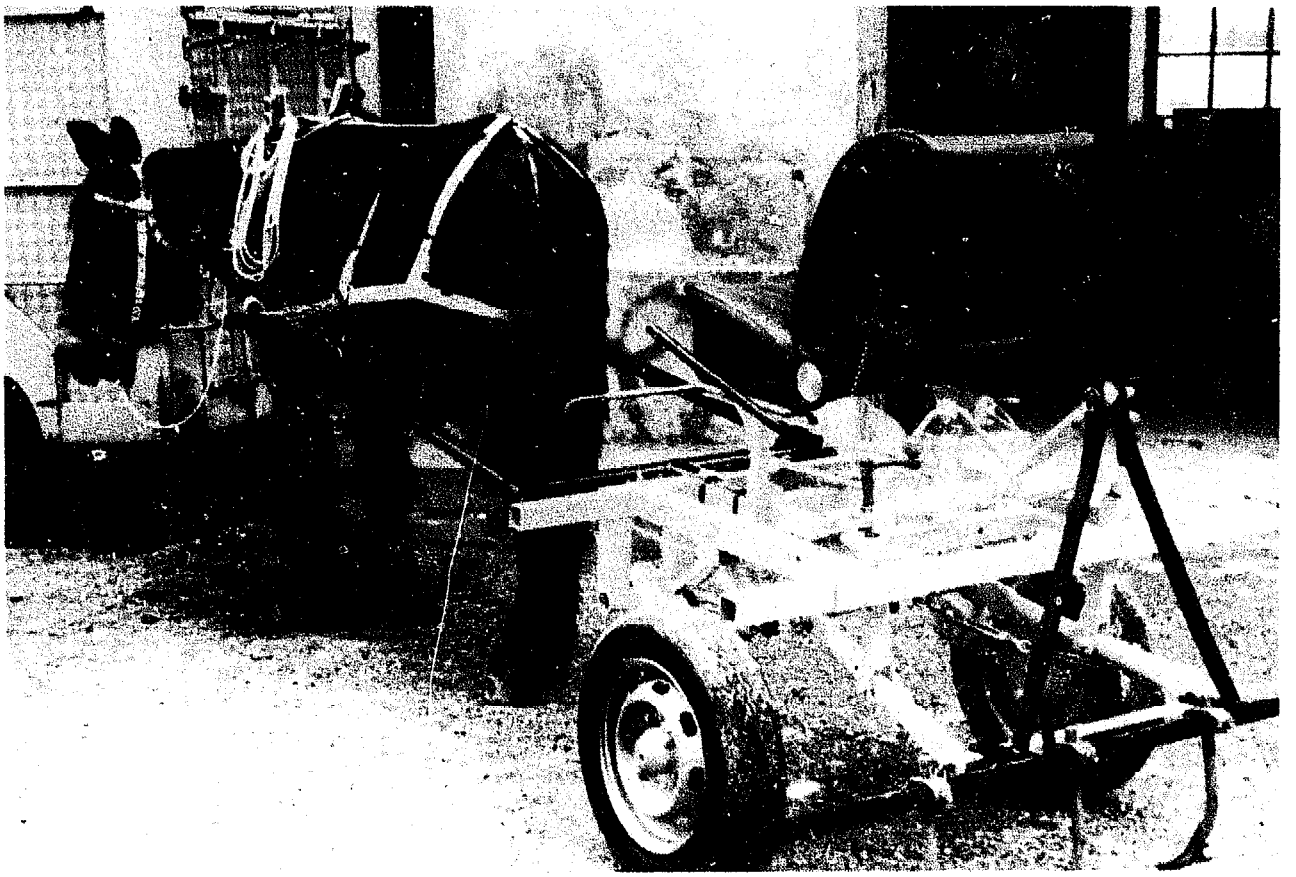


Fig. 8-3: Recent ATSOL wheeled toolcarrier with three-point linkage in France, 1985. (Photo: J.P. Morin).

have separate implements for each operation, as these can be left appropriately set up and adjusted. Multipurpose implements decrease flexibility as two options cannot be used at the same time. Most importantly multipurpose implements increase risk, as one breakage can mean that all implement options become unavailable at the same time. Thus multipurpose equipment is only justified if the cost savings are significantly large to compensate for the decrease in convenience and the increase in risk. The cost advantages of wheeled toolcarriers have been minimal, or nonexistent, and the inconvenience or complexity of changing modes has been such that in the long term farmers have used their implements for only one purpose. (There are many parallel examples of multipurpose implements being used for only one operation, and many western households have multipurpose tools or electrical gadgets left in one mode.)

It would seem that equipment developments that are most likely to succeed are those that reflect the historical trends of separate implements for plowing, for secondary tillage and weeding, for seeding and for transport. The undoubted success in West Africa of simple multipurpose toolbars does not negate this argument. The Houe Sine has succeeded in conjunction with a good single purpose seeder (the Super Eco) and the use of animal-drawn carts. It has been designed to combine only a small spectrum of different operations, and within this limited scope farmers have generally selected an even smaller range. As Jean Nolle noted in the very early stages (Nolle, 1986), the Houe Sine of Senegal (and the Ciwara of Mali) is mainly used as a multipurpose *tine cultivation* implement and in some areas the mouldboard plow attachment is seldom used. An innovation parallel to the Houe Sine can be seen in the multipurpose triangular cul-

tivator in Burkina Faso which is generally sold as a complement to a single purpose plow. These multipurpose implements in West Africa show similarities with the animal-drawn (wheeled) cultivators of European and American agriculture that were often used for several cultivation operations including harrowing, weeding, earthing up and raising root crops.

Multipurpose use has become a stated (Nolle, 1986) and unstated design philosophy. A major justification for both simple toolbars and wheeled toolcarriers has been the argument that these can be used to encourage row cultivation (Willcocks, 1969; Mettrick, 1978) and yet row cultivation has been seen to develop using single purpose implements. Thus multipurpose use should not be a *primary* feature of animal-drawn equipment design; rather it should be considered as one option for possible cost savings, in situations where consultation with farmers indicates that the inconvenience or risk factors would be tolerable.

8.4 Vested interests: propaganda or reporting

It must be recognized that individuals, projects, institutions and governments have their own vested interests and their own reference groups. This situation is unlikely to change significantly. The prospects for individuals' promotion will depend on the extent they please their organizations. The chance of a contractor being awarded another project to implement will depend on the impression of competence given in earlier ones. The success of non-governmental organizations in raising funds will reflect the public's perception of past achievements. National institutions and politicians will need to justify to their electorates the specific benefits of their activities to the nation. International centres and agencies will continue to worry about future funding, and will need to justify past funding by showing unequivocal results. Most national and international organizations will continue to work with short time horizons and be expected to produce tangible benefits quickly. All these pressures will tend to encourage the dissemination of favourable images, good public relations material, and even propaganda. However individuals and organizations involved in development should be aware of the dangers and strongly resist these pressures to distort information dissemination.

In the history of wheeled toolcarrier development, there has been an understandable tendency for all individuals and organizations involved to project a more favourable picture than was justified by the circumstances. As a result there has been less learning from each other's experiences, less efficient utilization of human and financial resources and consequently less overall progress. There have been very few attempts to publicize or evaluate disappointing results, presumably because this might be interpreted by the various reference groups as "failure". Yet it cannot be too strongly stressed that *negative lessons are not in themselves failures;* they are only failures if the institutions and individuals fail to learn from the experience. To spend time and money developing equipment that farmers reject does not necessarily mean that the money has been wasted, *provided the lessons are learned and shared.* Institutions funded by national or international aid agencies must be more willing to view "negative lessons" constructively, and not regard them as "failures" of which they should be ashamed. Learning involves both positive and negative experiences and if such institutions are only prepared to release positive information, then the world is losing a major chance to learn from their experiences.

Enthusiasm is a very desirable characteristic, and it is stimulating when this is evident in reports and publications. Measured optimism

is also challenging and encouraging. However selective dissemination of only positive information is dangerous and undesirable (it is also unacademic and unscientific). It is therefore most important that professionals can feel as proud of a well-presented *negative* lesson as a *positive* one.

8.5 Networking activities

Many of the problems associated with the last thirty years of the wheeled toolcarrier might have been avoided if there had been more active "networking". Networking implies developing an awareness of comparable programmes and the subsequent exchange of information through correspondence, newsletters, visits and meetings. This may be achieved through a formal organization with structure and secretariat, or simply by a series of networking activities.

Networking by itself is not a panacea, for unless combined with farmer involvement, critical analyses and genuine cross-fertilization of ideas and experiences the activities themselves can even be counterproductive. There have been examples of newsletters disseminating unrealistic information, meetings at which prejudices were mutually reinforced and "field visits" only to research station trials under optimal conditions. Even the success of the ICRISAT's research programme in having its on-station achievements widely known is due to many of the activities associated with networking. Through optimistic information dissemination by correspondence, newsletters, visits and meetings and consequential media attention very many professionals became aware of (part of) ICRISAT's experience. However, if professional seminars and meetings involve village discussions with farmers and if workers admit their problems as well as their successes, networking can play an extremely important role in constructive information exchange. Indeed much of the research for this publication was based on following up a large number of contacts gained from previous networking exchanges.

Networking would certainly not have prevented all the programmes reviewed here from starting or continuing. Indeed it is not even suggested that this would have been desirable for the technology deserved *some* attention. Rather it would have ensured that the lessons from one programme were carried forward to the next one. This would probably have meant that some programmes would not have started and others would have terminated more quickly, moving into more productive areas. This would have been beneficial in the allocation of budgets and human time, thus justifying the modest costs of networking.

8.6 Conclusions

It is difficult to assess the cost of the various wheeled toolcarrier programmes, but taking present-day prices of over US $ 1000 for an equipped toolcarrier, production of 10 000 toolcarriers would be worth over US $ 10 million. Allocating professional time to the design, testing, production and promotion of wheeled toolcarriers is much more difficult. Jean Nolle, NIAE and ICRISAT have together accounted for over fifty senior person years of development work. Research and development programmes in Senegal, The Gambia, Botswana, Tanzania, Uganda, Mexico, Brazil and elsewhere would have accounted for over twenty-five expatriate years and many more years of national experts. To this can be added all the smaller research and development initiatives in Cameroon, Mali, Nigeria, Malawi, Somalia, Zambia, Nicaragua, India and elsewhere which have made or tested prototypes. Clearly one is considering a total of more than one hundred senior person years and

several hundred years of less senior staff. In present terms this would represent a labour budget in excess of US $ 15 million. If one wanted one could go on to add miscellaneous costs such as transport and institutional overheads, and it is clear that similar work today would cost over $ 40 million. This can be seen either as a huge investment, or a very small proportion of international aid expenditure.

What has this achieved? It has led to a few competent designs of wheeled toolcarrier. These may perhaps be shown to be useful, although to date they have not been proven anywhere by farmer adoption and it must be admitted that prospects are not bright. If this is all, then most of the money has been wasted. This would have been a huge price to pay for such design work, particularly as there were competent models available twenty years ago.

The programme has also led to some lessons in agricultural engineering and equipment development which, if learned, could assist in many programmes in developing countries. However for these lessons to be learned there is a need for open-mindedness and exchange of actual experiences followed by careful analysis of what succeeded and what failed, and what were the more effective methodologies. Such lessons would be expensive but valuable.

Most importantly while the work referred to has been specific to one kind of animal traction equipment it has provided some very important and fundamental lessons that relate to a whole range of development issues. Among these are:

– The need to involve and consult with the end-user (farmer) at all stages of planning, implementing and evaluating research and development programmes.

– The great danger of developing inappropriate solutions if research is undertaken in unrealistic conditions, if domineering (top-down) research philosophies are adopted or if the criteria for excellence are based on maximizing technical efficiency rather than appropriateness to the needs of the farmers.

– The dangers of aid agencies, international centres and national programmes using their considerable influence and resources to promote through publications, subsidies, credit and gifts, inadequately evaluated technology.

– The significant effect that over-optimistic reporting or misinterpreted terminology can have in promoting a technology to individuals and organizations anxious to achieve quick and visible results.

– The current waste of human and financial resources through continued repetition of similar mistakes because professionals and organizations are seldom prepared to exchange with honesty their experiences and admit and openly discuss setbacks.

– The importance of regarding "negative lessons" as potentially valuable.

If these lessons could be learned, then the wheeled toolcarrier programmes would have been a small price to pay for such significant benefits. In view of the hundreds of millions of dollars spent each year by national and international development agencies, the cost of all wheeled toolcarrier projects could be vindicated by very small percentage improvements in the effectiveness of current programmes. If existing national and international research, development and extension programmes were to make their work more farmer-centred and started to share experiences more openly, the lessons will have been justified. Only if these valuable (negative) lessons are now ignored should past wheeled toolcarrier initiatives be considered expensive "failures".