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# Transfer to Africa of the resources and rewards from biotechnology: The need for a participatory approach

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## Abstract

The low adoption rate of new technologies by rural communities in developing countries in the 1970s and 1980s revealed a need for a different approach to the setting of research agendas and technology transfer. More recent programmes have shown a shift away from 'top-down' researcher-led projects, towards a 'bottom-up' participatory approach. Here, all stakeholders are extensively consulted and local people are actively involved in development initiatives, leading to more focused and community-driven solutions to problems.

Recognition of, and long-term investment in, the participatory approach is crucial for any organisation attempting to bring about change at a community level. Commitment at the institutional level is also necessary to make participatory research an integral part of programme design and management, rather than simply a 'bolt-on' to a more traditional mainstream approach.

The participatory approach also presents new challenges in terms of changing the mind-sets of researchers, requiring them to consider all stakeholders as valid participants in the programme. The researcher becomes more of a facilitator, empowering the whole community (particularly its most marginalised members) to take ownership of the project.

This paper aims to give a general overview of participatory research. It highlights important factors to consider when embracing the participatory approach, as well as discussing the new challenges it presents. Examples and case studies from Africa will demonstrate how greater emphasis on the process of mutual knowledge acquisition and decision making, rather than simply project outcomes, is now forming the basis of many community development projects in health and agriculture.

**Keywords:** *participatory research, stakeholder consultation, developing countries, adoption innovation, technology transfer*

## INTRODUCTION

Technology transfer and capacity-building in developing countries is high on the agenda of many donor agencies and national governments. Numerous non-government organisations (NGOs) are encouraging cross-border transfer of knowledge and capability to help the resource-poor regions of the world; there is also pressure for multinational industry to make new technologies and opportunities in both healthcare and agriculture more accessible to people in these communities. The need for additional funding in future to provide an incentive for such transfer is well

recognised. For example, the Global Health Fund was established in 2001 by the United Nations, and seeks to raise between US\$7 and US\$10bn to capitalise on scientific ideas that may target specific health problems of people in developing countries.<sup>1</sup>

Yet technology alone cannot solve the problems faced by many resource-poor people.<sup>2</sup> The introduction of new technologies to a community requires an understanding of local needs, culture and constraints in order for the transfer to be culturally sensitive and complementary to existing traditional practices. This is particularly relevant to development

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programmes affecting health and agriculture; industry must recognise the need for long-term investment in partnerships with local stakeholders and end-users to facilitate the acceptance and utilisation of new knowledge, products or tools by a community.

Biotechnology has a significant potential in the areas of health and agriculture for developing countries. Controversy about their use in these regions, however, means it is imperative for industry to develop new innovations based on the true needs of the ultimate end-user.

The essence of participatory research is its 'people-centred' approach. By focusing on locally defined priorities and perspectives, end-users are involved not only in priority-setting, but also in the design and implementation of the project.<sup>3,4</sup> Once the 'knowledge monopoly' traditionally held by the researchers is broken, local communities are empowered to address their own problems and devise possible solutions. Crucially, the participatory approach also embraces the needs of marginalised groups who may otherwise not be represented.<sup>5</sup>

## EVOLUTION OF THE PARTICIPATORY APPROACH

Development projects have traditionally been 'top down' with little involvement of, or consultation with, the people to whom they were targeted. The needs of local communities have often been identified from the researchers' perspective, or assessed following surveys or questionnaires completed by key representatives of the village or region. Although such strategies may involve tedious data analysis, possibly based on inaccurate or irrelevant information, they have been an integral part of the widely accepted model for needs assessment.<sup>6</sup> Following such appraisals, the researchers developed a new product or tool, and extension providers promoted its adoption to the community. The end-

users then decided whether the technology was suitable.<sup>7</sup>

Over the last two decades, poor adoption or acceptance of new technologies has been noticed in many rural communities, including those in South East Asia, sub-Saharan Africa and Latin America (for examples, see Chambers<sup>8</sup>). This phenomenon is particularly well illustrated by Kenyan agricultural innovation. Research programmes at the national Kenyan Agricultural Research Institutes (KARI) have traditionally been driven by a 'farming systems' approach. The realisation in the mid- to late 1980s that KARI scientists needed to identify and respond to farmers' needs more effectively led to the participatory approach to agricultural research being more widely adopted in Kenya.<sup>9</sup>

Participatory research spread from Ethiopia, India, Kenya and the Sudan in the 1990s.<sup>6</sup> It is now used as a basis for many international development projects, such as those managed or funded by the Rockefeller Foundation, the World Health Organisation, ISAAA (the International Service for the Acquisition of Agri-Biotech Applications), CGIAR (the Consultative Group for the International Agricultural Research) and CIMMYT (the International Maize and Wheat Improvement Centre). Other development and donor organisations are also supporting participatory research programmes, in addition to some projects in Europe.

## METHODOLOGY OF THE PARTICIPATORY APPROACH

### Choice of participants

The decision about whom to invite to participate in a project, and how they are involved is a important one. Many stakeholders might be affected, so it is vital to consider who will best contribute to a representative group without excluding the most marginalised.<sup>5</sup> Cultural and gender issues are particularly important in the selection of participants.

**Participatory research is user-led**

**Failure to consult has led to poor adoption of new technologies**

**Careful selection of participants is crucial**

For example, the wealthiest and most respected member of the community, such as the headman, may be the most suitable in terms of articulating community needs and mobilising available resources.<sup>3</sup> In practical terms, however, he may not be the most appropriate participant for programmes addressing topics such as women's health and birth control.

Similar sensitivities apply in participatory agricultural research. Although the majority of African farmers are women, they generally do not own land – decisions about land use are made by their husbands. A woman may therefore be unable to make the crucial choices about crops or husbandry. An additional complication may be the cultural division of labour that sometimes exists between genders; for example, African men do not plant bananas, which is viewed as women's work.<sup>9</sup>

Objective decisions must be made about the suitability for a region for the project, based on factors such as local needs, infrastructure, access to hospitals, or in the case of agriculture, climate, soil type and proximity of markets. If the project outcomes are to be transferable to other regions, one or more representative areas may have to be selected.<sup>10</sup>

**The participatory rural appraisal (PRA)**

This is the mechanism by which community needs are initially assessed in consultation with all stakeholders to decide on future priorities and direction of development projects.<sup>11</sup> It was first used mainly by government field organisations and NGOs and recognises the importance of building not only on local knowledge, but also on the analytical capabilities of individuals in rural communities. These can include use of seeds, stones or sticks to represent numbers and proportions, or to score and rank priorities and needs. These visual techniques can help reinforce verbal exchanges. Additionally, the progression

of time or seasonal changes can be demonstrated using time lines and trend lines, again depicted visually. For example, participatory diagnoses of a range of cattle-wasting diseases in Sudan were carried out between researchers and local livestock keepers using matrix scoring based on a local recreational game.<sup>12</sup> Seeds or stones were moved by the 'players' into a set of holes dug in the ground, with each hole representing different disease symptoms of cattle. Striking similarities were observed in the accuracy of diagnosis using this approach compared with post-mortem and histology-based techniques. This led to the development of new vaccines, preventative measures and better information for livestock keepers about treatments for the different conditions.

The participatory approach does not decri the use of surveys and questionnaires, but these tend to be semi-structured rather than following a pre-determined list of questions. Surveys used in participatory research tend to be more open-ended, and so allow the interviewer the flexibility to pursue anything unexpected.<sup>6</sup>

A useful tool to encourage a move away from the development 'expert' towards the more humble listener and learner is the use of 'do-it-yourself'. This enables the local community to share their expertise and tools with the researcher. As well as being a useful information-gathering process, it is also a valuable mechanism for instilling respect in a researcher who might inherently believe his or her knowledge is superior and that the knowledge and capacity of the locals to measure and analyse were inferior.<sup>11</sup>

The recognition that the participatory approach demands a move away from a 'director' status is a challenge for many researchers.<sup>3</sup> Instead of briefly visiting a regional community to collect extensive data for statistical analysis, the programme director takes on more of a facilitation role, encouraging the local production and analysis of information according to the priorities of the community.

**Local knowledge and analytical capabilities should be harnessed**

**Researchers become listeners, not directors**

**Communities need help to recognise and devise solutions to their own problems**

### **Community empowerment**

Central to the success and sustainability of development projects is empowerment of the community to identify their own problems and devise ways of solving them. This may take a long time, and may need external support and technical input,<sup>13</sup> but it should be the ultimate goal. The first step, however, is helping the community realise their own potential and resources. This involves in-depth introspection and self-analysis of the current situation. Only then can the possibility of change become a reality.

A striking example of this was reported<sup>14</sup> following work within a community in the Midrand region in South Africa, which was suffering from health problems associated with over-population, poor living conditions and unemployment. A group of volunteer patients who had been attending the local clinic worked with facilitators from the University of Pretoria to analyse their current situation and consider how they could bring about positive change. They identified issues such as good nutrition, sanitation, family planning and personal safety as being central to improvement. This led to community-driven initiatives to teach children songs containing these messages in schools, using lessons to make banners and posters with social messages, organising exercise classes to improve the physical strength of women and implementing a community 'whistle project' to draw neighbours' attention to violent personal attacks.

A similar story has emerged from regions in Tanzania,<sup>13</sup> where maternal mortality is high during childbirth. A capacity-building programme helped the communities in 50 rural villages identify transportation to emergency obstetric care as a major factor leading to death. As most local people believed transport was the sole responsibility of the mother, no publicly available facilities were in place. Leaders from each community were trained in facilitation and problem-solving, and they in turn held meetings with members of their own villages.

Initially plans were made by the villagers to acquire transport, with a range of ideas from tricycles with platforms on the back, to canoes being identified as possible solutions. These ideas often had to be adapted by the community as they proved unworkable, too expensive, or better alternatives came along. After continued support and technical input from the researchers, 28 communities had action plans, 19 had collected funds to implement their plans, and 13 had functional systems in place. The initial goal to provide emergency transportation for pregnant women has revealed an even longer-term goal; that of community ownership of health problems.<sup>13</sup>

### **Monitoring success**

Participatory research is a dynamic, mutual learning experience for both researchers and members of the local community.<sup>10</sup> One of its drawbacks, however, is that quantitative, statistically significant analysis of the success of the completed project can be difficult.<sup>15</sup> Yet a means of monitoring the impact of development projects is crucial, not simply to monitor success, but also to justify further investment.

It is important that the output indicators of the programme are carefully considered. The values and objectives of a programme must reflect those set by the community, as well as the donor organisation and programme manager. It is important for the donors to bear in mind possible disparities between satisfactory performance indicators from a developed country perspective and that of a local African community.

Once the technology has been introduced, continuing support to the community is vital. As well as helping ensure the appropriate management of the technology, this also allows new issues to be addressed. This helps the local community view the programme as an ongoing sustainable partnership, rather than a transient aid exercise. This, in turn, helps to break the dependency attitudes that have become entrenched in some

**Participatory research might not yield quantitative performance indicators**

**Ongoing interactions between researchers and the community is vital**

communities who have received donor aid in the past.<sup>4</sup>

### **CASE STUDIES FROM AFRICA**

Examples will be discussed highlighting the application of the participatory approach by two organisations operating in Africa using biotechnological applications to address agricultural constraints.

#### **Biotechnology Trust Africa (BTA)**

BTA was established in 1992 by the Netherlands Minister for Development Co-operation, with the 'bottom-up' multidisciplinary approach underpinning all its initiatives. Its remit is to improve agricultural and health services and to encourage sustainable environmental practices in Africa. The criterion for success is a direct positive impact on the resource-poor farmers in developing countries. This ultimate objective was set alongside existing national development goals and available resources, but, importantly, involves consultation at all levels as to the suitability and success of each project.<sup>4</sup>

The agricultural arm of the BTA programme began in 1993, with a needs assessment of small-scale farmers. Tools of PRA were used to carry out feasibility and/or socio-economic studies of the projects. This was achieved through farmer/scientist workshops to identify problems, and, crucially, to encourage the farmers to suggest possible solutions. Four stakeholder meetings (consisting of farmers, extension providers, researchers and the programme managers) were subsequently held to help prioritise the possible applications of biotechnology in this context.

Organisations with the relevant expertise in these areas were then identified and invited to participate. In total, ten project proposals were developed and independently reviewed. Two workshops were held to consult farmers as to the benefit of these

proposals. At this stage, a tissue culture-based agriforestry project was rejected by the farmers. They viewed the project as a low priority as it involved raising species that the farmers could raise themselves using conventional methods. The remaining nine project proposals were supported by the farmers so were subsequently funded and implemented.

During the research programmes, farmers were actively involved in the provision of information about starter material or crop varieties, and were consulted about field station trials and establishing on-farm trials. This enabled the local indigenous knowledge and practices to be incorporated into the research programme. Farmers then advised on the dissemination of the technology 'package' to other producers.

To date, BTA has funded the successful development of disease-free banana, citrus, sweet potato and cassava (using tissue culture), and the formulation and provision of a vaccine against Newcastle disease in poultry. Certified seed potatoes are now available to farmers, and farm trials of crop sprays based on the Bt toxin are currently underway. BTA has been working with seven different research institutions, establishing laboratories and providing training for scientists in techniques of tissue culture, molecular biology and technology transfer. Farmers and extension staff are also receiving training in communication and crop husbandry.

Consultation with stakeholders and end-users continues. The farmers receive support from the scientists and extension providers about the new technology, and can continue to feed in to research programmes. For this to be truly an ongoing programme, however, long-term funding commitments are needed to support a dynamic response to new needs as they arise.

#### **International Service for the Acquisition of Agri-biotech Applications (ISAAA)**

ISAAA is a not-for-profit organisation co-sponsored by public and private sector

**Farmers help determine some research agendas**

**Public/private partnerships can help broker relations between researchers and farmers**

institutions to facilitate transfer of crop biotechnology applications from developed countries to benefit developing countries.<sup>16</sup> Four major programmes are underway, with ISAAA AfriCentre having negotiated the donation of the technologies from other institutions, including industry. These include the development of a genetically modified sweet potato resistant to feathery mottle virus, resistance to maize streak virus, large-scale propagation and distribution of disease-free eucalyptus trees, and the development and distribution of tissue-culture (tc) bananas.

To consider the case of the banana project in more detail, participatory rural appraisals were carried out in four different regions, each with over 150 farmers in attendance. Here, the lack of clean planting material, and pest infestation of existing banana orchards were identified as major constraints to successful production. As 24 per cent of Kenya's bananas are grown on a subsistence basis, this was significantly affecting the quality of rural life.<sup>9,16</sup>

During the PRA, the ISAAA researchers worked with local farmers to explore issues of cultivar choice (to suit grower and consumer preferences), compatibility of the tc approach with existing practices, gender constraints and the impact of the higher cost of growing tc bananas. This enabled the research programme to be tailored specifically to the needs of the farmers.

In collaboration with DuRoi Laboratories in South Africa, KARI and QTL Laboratories (a local private company), a large tc programme was funded and developed to provide disease-free banana plantlets to farmers in the Muran'ga and Muragua regions of Kenya. Other partners, including community-based organisations, and the African Technology Policy Studies were also brought into the programme to deliver advice to farmers on distribution and marketing, and research strategy.<sup>16</sup>

One farmer sold her entire tc banana crop for US\$300 in one day – more than

she usually earns in a year from bananas grown in her traditional orchard. With this money she was able to build a new kitchen. She cites this new kitchen as having made a dramatic and positive change to the health and quality of life for her family, as they no longer suffer from breathing problems due to smoke inhalation from having to cook in the living room (Esther Gachugu, smallholder farmer, Muragua region, Kenya; personal communication).<sup>9</sup> Socio-economic studies have revealed that the average family monthly income of small-scale farmers growing tc bananas has increased by an average of 38 per cent.<sup>17</sup>

It is, however important to bear in mind the criteria for success of all the stakeholders affected by the tc banana programme. The farmers' criterion for success was identified as increasing their yield and income – essentially increasing their net return for labour. The data so far suggest this has been achieved at the farm level. From a wider socio-economic perspective, however, it is less meaningful to judge the rate of technological progress simply as an increase in total productivity. According to Qaim,<sup>17</sup> the increase in yield and income was only partly due to a shift in production. New knowledge, altered practices and other factors that altered the previous input mix are more likely to be responsible for the proportion of gains following the adoption of tc bananas. On a national scale, economic forecasts and models based on the farm data suggest a projected annual benefit from tc bananas to be between 94,000 Kenyan Shillings (KSh, around US\$80,000) and 764m KSh (around US\$650,000) by 2020. These calculations were based on estimated adoption rates after 5, 10 and 20 years, for small, medium and large farms, under various assumptions for the price of the original tc plantlets.

Regular monthly meetings continue to be held between the farmers, the researchers who developed the bananas, extension providers and advisors on microcredit and finance. A valuable

feature of the ISAAA programme is its ability to continue to respond to farmers' needs, and to re-set its objectives accordingly. For example, following the successful cultivation of tc bananas, the farmers have identified new constraints to production. They include the increased cost of the tc banana plants compared with the conventional varieties, and marketing and distribution of the crop. The ISAAA programme directors are therefore responding with a microcredit scheme to finance the purchase of tc plantlets, as well as marketing advice and training.<sup>9</sup> Work is also underway to set up local marketing centres and new road haulage opportunities to exploit other distribution outlets further away from the farm.

There are hopes to extend this project to Tanzania and Uganda, as well as build on the lessons learnt in tissue culture technology for other species such as cut flowers, pyrethrum and sugar cane.

### CHALLENGES OF PARTICIPATORY RESEARCH

Participatory research is, by its nature, more time-consuming and labour intensive than the mainstream approach.<sup>3,4</sup> It also requires a longer-term investment in capacity-building and forming community relationships, which must be factored into budgets. For example, a recent analysis of the total costs incurred by a two year review of primary healthcare services in the Mpumalanga province of South Africa revealed an additional 14 per cent of costs due to its participatory nature.<sup>18</sup> These additional costs included time and resources for consultation meetings and workshops, as well as higher transport costs arising from more frequent visits to the region.

A second issue is that there is a danger of raising false hopes within the community at an early stage, which does not deliver the promised benefit. A delicate balance must be struck between generating enough enthusiasm to secure

participation, but still being realistic as to what it can deliver.<sup>4</sup> Too many development projects in the past seem to have failed to achieve this balance. For example, one rural farmer in Kenya views community development projects with some suspicion, commenting 'we have had empty promises in the past' (Samuel Kamau, smallholder farmer, Murang'a region; personal communication). This has adverse implications for participation in subsequent projects, and in reducing trust in researchers.

Changing the mindset of the researcher is one of the biggest difficulties to successful participatory research. It can take time for academic scientists to appreciate the benefits to be gained from genuine participation of the end-user,<sup>4</sup> and not view stakeholder consultation and involvement simply as a 'bolt-on' to the traditional systems-based approach.<sup>5</sup> As one Kenyan agricultural scientist allegedly commented, 'a farmer should not argue with a Professor' (Joseph Wekundah, manager, BTA personal communication). This perceived social distance between farmers and scientists is a potential problem that must be handled sensitively if it arises.<sup>19</sup> Providing the community with a communication channel to voice opinions, express demands and serve as viable partners is fundamental to empowerment.<sup>20</sup>

It is important that participatory research projects are not 'hijacked' so that the research agenda becomes externally driven and used simply to create a veneer of legitimacy for projects, agencies and NGOs. To this end, it is vital participatory research is not viewed as a panacea, a problem that has been identified by some veterinarians working in the Samburu district of Kenya.<sup>15</sup>

The likelihood of widespread acceptance of participatory research at the institutional level is still unclear.<sup>15</sup> The examples cited here have shown the crucial need for training and shifts in attitude among those involved 'on the ground' but it is also important that this

**Researchers must fully commit to participation to ensure success**

**Participatory research requires more input over a longer time**

**Research agendas should not be 'hijacked'**

**There is a danger of raising false hopes**

occurs at an organisational level as well. This might involve training of senior personnel as well, in order to help the whole institution commit to learning and change in mindset and attitude.

## CONCLUSIONS

The case studies cited here show that a carefully planned, properly supported participatory programme can be instrumental in the adoption of new technology by developing countries. The additional time and investment required, however, may be a disincentive for some organisations to embrace this approach. It is therefore imperative that funding opportunities are in place to aid the development of suitable ideas that could benefit rural communities. Crucially, these ideas must be developed with the needs and context of the end-user in mind. Hopefully such funds and incentives will help increase the technological options for developing countries, as well as giving industry the incentive it needs to invest in these regions.

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### References

1. Singer, P. A. and Daar, A. S. (2001), 'Harnessing genomics and biotechnology to improve global health equity', *Science*, Vol. 294, pp. 87–89.
2. Alvarez, D. (2001), 'Bridging the public/private divide: the essential role of fellowships', *Crop Biotech. Brief.*, Vol. 1(3) (URL: <http://www.isaaa.org>).
3. Cornwall, A. and Jewkes, R. (1995), 'What is participatory research?', *Soc. Sci. Med.*, Vol. 41, pp. 1667–1676.
4. Biotechnology Trust Africa (2001), 'The concept and activities implemented by Biotechnology Trust Africa (BTA)', Kenya Netherlands Biotechnology Programme, BTA, Nairobi.
5. Kapoor, I. (2001), 'Towards participatory environmental management?', *J. Env. Management*, Vol. 63, pp. 269–279.
6. Chambers, R. (1994), 'Participatory rural appraisal (PRA): challenges, potentials and paradigm', *World Development*, Vol. 22, pp. 1437–1454.
7. King, R. N. and Rollins, T. J. (1999), 'An evaluation of an agricultural innovation: justification for participatory assistance', *J. Extension*, Vol. 37 (available at URL: <http://joe.org/joe/1999/august/rb2.html>).
8. Chambers, R. (1994), 'The origins and practice of participatory rural appraisal', *World Development*, Vol. 22, pp. 953–969.
9. Wambugu, F. M. (2001), 'Modifying Africa; How Biotechnology can Benefit the Poor and Hungry. A Case Study from Kenya', Nairobi, Kenya. Available from URL: [www.modifyingafrica.com](http://www.modifyingafrica.com).
10. Bellon, M. R. (2001), 'Participatory research methods for technology evaluation: A manual for scientists working with farmers', D.F. International Maize and Wheat Improvement Centre (CIMMYT), Mexico.
11. Chambers, R. (1994), 'Participatory rural appraisal (PRA): Analysis of experience', *World Development*, Vol. 22, pp. 1253–1268.
12. Catley, A., Okoth, S., Osmna, J., Fison, T., Njiru, Z., Mwangi, J., Jones, B. A. and Leyland, T. J. (2001), 'Participatory diagnosis of a chronic wasting disease in cattle in southern Sudan', *Preventative Vet. Med.*, Vol. 51, pp. 161–181.
13. Schmid, T., Kanenda, O., Ahluwalia, I. and Kouletio, M. (2001), 'Transportation for maternal emergencies in Tanzania: empowering communities through participatory problem solving', *Amer. J. Public Health*, Vol. 91, pp. 1589–1590.
14. Templeton, L. E. and van Wyk, N. C. (1999), 'Health-related problems and proposed solution identified by women in Ivory Park, Midrand. A participatory approach', *Curationis*, Vol. 22, pp. 75–82.
15. Catley, A. (2000), 'The use of participatory appraisal by veterinarians in Africa', *Rev. Sci. Tech. Off. Int. Epic.*, Vol. 19, pp. 702–714.
16. Wambugu, F. M. and Kiome, R. M. (2001), 'The Benefits of Biotechnology for Small-scale Banana Producers in Kenya', ISAAA Briefs, Vol. 22, ISAAA, Ithaca, NY.
17. Qaim, M. (1999), 'Assessing the Impact of Banana Biotechnology in Kenya', ISAAA



- Briefs, Vol. 10, ISAAA, Ithaca, NY.
18. Doherty, J. and Price, M. (1998), 'The cost implications of participatory research', *South African Med. J.*, Vol. 88, pp. 390–393.
  19. Bentley, J. W. (1994), 'Facts, fantasies and failures of farmer participatory research', *Agri. Human Values*, Vol. 11, pp. 140–150.
  20. Merrill-Sands, D. and Collion, M.-H. (1994), 'Farmer and researchers: The road to partnership', *Agri. Human Values*, Vol. 11, pp. 26–37.