2003 Science and Innovation Award for Young People in Agriculture, Fisheries and Forestry

A Framework for the Social Evaluation of Genetically Modified Crops in Australia

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Summary

The aim of the project was to provide a tool for the assessment of biotechnologies, particularly genetically modified (GM) varieties, and their contribution to sustainability in rural Australia, focussing on social aspects. A case study was conducted to investigate themes and social issues that have arisen in a community in which genetically modified (GM) crops are currently in commercial use. This scoping study, conducted in 2004, centred on the cotton-growing town of Wee Waa, in NSW. It involved 11 focus groups with stakeholders in the community (5 participants, on average, in each group), including cotton farmers, women in the cotton industry, workers from agricultural service industries, weed management businesses and cotton companies, cotton consultants, non-cotton farmers, community and welfare workers, Aboriginal community members and members of the general community. The focus groups discussed the framing concepts, sustainability, social sustainability and biotechnology; and then described community values and general threats to the community; before going on to discuss opportunities and threats arising from biotechnology, particularly GM cotton (participants did not have much knowledge of other applications of biotechnology).

The two GM cotton varieties in use in the cotton industry were found to have different social 'performance'. RoundupReady cotton appears to have caused significant loss of employment in displacing cotton 'chipping' (hand weeding). This has caused impacts on individuals, including disadvantaged members of the community, and on communities, especially small towns that rely on an influx of seasonal itinerants to sustain commerce. However, social benefits may also come when the social burden imposed by itinerant workers is removed. It is also important to note that other trends have affected the availability of this kind of work, notably occupational health and safety (OH&S) requirements. At the same, time while RoundupReady cotton has simplified weed management for farmers and may have caused some reductions in herbicide use, it has not contributed to farmers escaping the agrochemical treadmill, and has caused increased use of Roundup, with implications for competition in agrochemical supply and a risk of Roundup resistance in weed populations.

Bt cotton performs better in reducing agrochemical use and in potentially encouraging and facilitating integrated pest management (IPM) (although this link should not be taken for granted). There are social benefits associated with reducing chemical use and IPM, particularly if area-wide management is also adopted. These benefits include alleviation of health concerns and divisions in the community, improvement of the image of the cotton industry, increased interaction between farmers and more active and engaged decision-making. These benefits may be threatened by monopoly control of the technology, and the effects this has on farmer choice and control, and on pricing.

In raising relevant questions for social research into the effects of biotechnology use, and in considering methodological issues in determining the effects of new technologies in social setttings, it is hoped that this study will contribute to the development of a model for the social assessment of new technologies. Research to develop such a model is ongoing, and the next stage, in which information about social effects is discussed with R&D and policy personnel, is underway. This ongiong research will be supported by a successful ARC Discovery grant (with Frank Vanclay, Uni of Tas and Heatheer Aslin, BRS) in 2006 - 2008.

Objectives

The aim of the project was to provide a tool for the assessment of biotechnologies, particularly genetically modified (GM) varieties, and their contribution to sustainability in rural Australia, focussing on social aspects. The specific objective was to develop an evaluation framework incorporating community consultation and participation, which could feed information about social consequences of agricultural technologies and innovations back to R&D decision-makers and policy-makers. The project involved a case study in a community currently affected by commercial use of biotechnology. As well as playing a scoping role in raising issues and themes associated with biotechnology use and considering appropriate methods for investigating these issues, the case study provides information about social aspects of GM cotton use in NSW. It is hoped that tools and approaches for social assessment can be developed which can be used in a predictive capacity for future applications of biotechnology.

Background to research project

Biotechnology has great promise in contributing to agricultural productivity and sustainability. Like all technologies, it also has the potential to cause social and environmental impacts. Concern about the risks of biotechnology has given rise to public opposition, particularly to genetically modified organisms (GMOs). The movement against GMOs, particularly in Europe, has raised broader issues about the design and introduction of technology and its governance and regulation. In particular, the question of public involvement in decision-making has been raised.

In Australia, questions about the regulation and governance of biotechnology have been highlighted in the recent case of GM canola. Applications to release GM canola were approved by the Federal statutory body (the Gene Technoloy Regulator) in 2002, but were effectively overturned by State Governments responding to public opposition. This opposition mostly related to market issues, particularly for non-GM canola growers, and grower choice and control in the face of GM contamination. The moratoria set up by States in response to the GM canola issue highlight the importance of mechanisms to consider socio-economic issues and to incorporate such considerations into technology governance.

The focus of this project on social consequences of GM technologies responded to the need for mechanisms for social assessment and to the paucity of empirical research on such aspects. Research has been conducted on the agronomic and biological performance of GM crops, and to a limited extent on their economic performance, but very little research has considered their social 'performance'. Social changes related to the introduction of new technologies are central to rural sustainability and regional development. For example, changes in farming practice and management strategies, changes in farm size and industry structure, changes in employment and demography in rural areas, all influence the sustainability of agricultural industries, environments and communities.

Materials and Methods

This report presents the results of a case study based in a small cotton-growing town, which involved focus groups with various relevant groups or stakeholders in the community. The case study was around the town of Wee Waa, in central northern NSW, and was conducted in 2004. Wee Waa was chosen because it is the historic centre of the NSW cotton-growing region and its relatively small population (approx. 2000) relies heavily on the cotton industry. The NSW cotton industry has been using GM cotton varieties, both insect-resistant *Bt* (Ingard® and Bollgard® II) and herbicide-tolerant RoundupReady® varieties, since 1996. It is also an ideal study site because of its vicinity to the Australian Cotton Research Institute, which is the current headquarters of the Australian Cotton Cooperative Research Centre (Cotton CRC) and to other organisations important to the introduction of GM cotton, such as Cotton Seed Distributors, which markets the GM cotton varieties. The year of the study, 2004, was the eighth year of use of GM cotton and was characterised by an ongoing drought (one of the challenges of the study was to tease apart the effects of the drought and of GM cotton use).

The case study was a 'community evaluation': an evaluation of the technology *in relation* to the community, and *with the involvement* of the community. I should emphasise that the evaluation was not conducted by the community; it was conducted by myself. The research involved focus groups with 'stakeholders'[1]. The original proposal included a community forum to bring stakeholder groups together, but it was decided in the initial stages of the research that focus groups with separate stakeholder groups would be more feasible and cost-effective and would provide a richer picture, while avoiding much of the conflict that potentially surrounds this issue. Initially, potential stakeholder groups were selected based on information gathered about the community and the cotton industry and contact was made with key people who became contact people. In some cases, these contact people approached members of a stakeholder group, inviting them to participate in the study. In other cases, a snowball technique was used to contact members of a particular group, by email, fax, mail or phone and invite them to participate. All potential participants were given information about the project (see attached information sheet) and all signed a consent form at the beginning of the focus group (see attached form). There were eleven focus groups involving between three and ten people (57 people participated in total). The participants are identifiable by the researcher, but will remain anonymous in reporting the study.

The stakeholder groups were:

Cotton Farmers (area-wide management group)
Women in cotton
Agricultural service industries
Cotton consultants
Community and welfare workers
Cotton Farmers (cotton growers' association members)
Aboriginal community members

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[1] 'Stakeholder' was used in a very broad way here to indicate a person with a (not necessarily economic) interest in the use of GM technology, or a person who may be affected by this use.

Weed management (aerial sprayers, chipping contractors)
Community group
Non-cotton farmers
Marketers, processors

The focus group process took approximately 2 hours and was structured around a set of questions (see attached). Preliminary questions sought information about the views of participants on framing concepts including sustainability, social sustainability and biotechnology, and were also used to communicate my understandings of these concepts as the researcher. A community values exercise was then run, which involved participants writing values (things of value) on cards, working individually; the cards were then stuck up on a wall and discussed by the group. The group was then asked to discuss general threats to the community/community values before the discussion turned to opportunities and threats from biotechnology specifically. The follow-up questions were not explored in any of the focus groups (because of lack of time). I made notes on butcher's paper on the wall as the discussion progressed. These were used mostly to structure the discussion and were not a major part of the analysis.

The focus groups were taped and the tapes transcribed. Rapid analysis of the transcripts lead to preliminary reports for each focus group, most of which have been completed and sent out to participants for extra feedback and to make sure that participants were happy that the report did not misrepresent them, or present anything they wished to withdraw. Only a few of the participants have responded to date. The reports and transcripts will be further analysed using NVivo qualitative research software to elaborate on major themes, compare between groups etc. This detailed analysis is in progress.

The case study required a full year and most of the available funds from the Science and Innovation award. The aspect of the proposal that sought to interact with R&D and policy decision-makers about community-level effects of biotechnology has evolved into the next stage of the research. This second stage involves feeding the information from the community evaluation back to the research and development community, to technology providers and to policy personell. To this end, a workshop was held at the Cotton CRC, in which I presented the results of the study in a seminar to all interested parties at the CRC, and then conducted three focus groups, with managers, researchers and extension and liaison personell to investigate their responses to the study and its findings and to discuss how research of this kind could inform the R&D process. These focus groups will be analysed in a similar way to those in the first stage. Similar workshops are planned for technology providers (Cotton Seed Distributors and Monsanto) and funding has been requested from DAFF for a similar workshop with State and Federal policy personnel. Some additional funding from the Aus cotton CRC will also support this work. The development of the evaluation framework is an iterative process that will evolve with each stage. Funding has recently been granted from the Australian Research Council for the development of a technology assessment framework. This project will dovetail with the DAFF-supported project, which will lay the foundations for a more broadly applicable evaluative framework.

Results & Discussion

Framing concepts

Sustainability, though much in vogue, is a problematic concept, particularly when applied in a broad way or on a small scale. When applied specifically to particular resources at a national level, for example, one can consider stocks and flows and the maintenance of supply to meet demand. It may be possible to measure sustainability in various ways. However, when considering an industry or, even more broadly, a community, at a local level, determining 'the sustainability' of the industry or community becomes more elusive. The principle difficulty is that things always change and evaluating the ability to sustain something requires a definition of which particular state or which characteristics are to be sustained. This is particularly the case when one considers 'social sustainability'. There are many dimensions of a social 'system', and such systems tend to be very open, changing constantly in response to internal and external trends.

The concepts, sustainability and social sustainability, were central to the framing of the project. This was partly in response to the popular use of these concepts in policy, both public policy and statements from private and industry bodies. The research highlighted the contested and often contradictory nature of these concepts. Rather than hindering the project, however, my view is that the challenges and tensions inherent in discussions of sustainability and social sustainability created opportunities for fruitful discussion and consideration of a range of issues. Particularly in opening up the focus groups to a discussion of what these concepts mean, despite some skepticism about their use, the process initiated a conversation about values and futures for rural communities. It was an intention of the project to consider gene technologies not only in relation to the *status quo* and broader current trends, but also to consider its role in future visions.

Many of the focus groups made a strong association between sustainability and environment, particularly conservation, but also highlighted the importance of economic aspects, of profitability. Interestingly, a minority of groups, notably the women in cotton and employment and community workers, referred to social (including community) dimensions without being prompted when discussing sustainability. There seemed to be a sense, particularly from industry groups, that the push for sustainability has come from government, from 'Greenies' and from 'city' people generally. Sustainability was considered by many to not allow for improvement, but to imply 'keeping things the same'. There was a sense that it is a concept used to impose restraints on farming from above, often without adequate consultation with country people or understanding of rural issues. It was pointed out that there has traditionally been a sustainability ethic (although not necessarily described as such) among farming people for whom farming has been an intergenerational activity.

The term biotechnology was discussed in order to establish a common definition for the research, but also to gauge groups' understandings of biotechnology. Across virtually all of the groups, biotechnology was understood in either narrow terms, referring specifically to genetically modified varieties, or in very broad terms, referring to "any new technology affecting living things", which included plant breeding. When asked about 'modern' biotechnology, which was the focus of the study (excluding 'traditional' breeding), again they felt that there was enormous potential and

promise and in fact showed considerable optimism, but were not able to describe particular applications of biotechnology apart from GM. Given that most participants had quite a high level of knowledge about new varieties developed for the industry and cotton research generally, it seems that there is a deficit of information about genomics, molecular markers, diagnostics and other biotechnology applications, including research tools, of relevance to their industry. This is unfortunate, as these other applications may have as much to offer in agriculture as GM varieties.

Community values and threats

There was a high level of commonality between groups when discussing community values. Most people appreciated the quality of life in a country town, including environmental aspects such as clean air, access to clean water, space and health; but also social aspects such as safety, community, pride, spirit and generosity. They also put strong emphasis on the provision of services and infrastructure, not just as valuable to the town but as key to its survival. These include a range of medical services, education, childcare, aged care, community services, transport infrastructure, sporting and entertainment facilities and a range of local businesses. The availability of stable employment and political representation and government were also listed. Interestingly, the groups did not mention specific aspects of place when discussing their community values, except the river (the Namoi) and the levy bank that defines the town.

Major threats discussed by the group (those not specifically associated with biotechnology) included loss of services and infrastructure and loss of employment. While these two things are linked, and loss of farm employment during the drought and with the use of GM cotton has influenced the size of the town and the viability of local businesses and services, there are broader trends operating. Consolidation and centralisation of government and services has had a considerable influence. For example, shire amalgamation resulted in local government moving from Wee Waa to Narrabri and more recent changes in area health services has meant that Wee Waa is part of the New England health service, centred in Armidale. Consolidation of farms has also lead to smaller farms with fewer employees and some of the larger cotton industry bodies have begun to move their operations to larger towns such as Toowoomba. Employment, services and population size are all intimately connected in a small town.

Another general threat came from the requirements for compliance with new legislation and standards in areas such as occupational health and safety, workers' entitlements, public liability and drink driving. Participants generally, when asked, acknowledged that there had been a need for improvement in some of these areas, but many felt that things had gone too far, both in the standards that have been set, and the reporting and monitoring requirements associated with them. There was also a feeling that many of these requirements were designed for cities and were not appropriate to rural areas. Once again, this feeling was heightened by the sense that laws are made by city people without consideration of, or consultation with, country people.

Changes associated with biotechnology

The most significant social changes associated with the introduction of GM cotton varieties were losses of employment in cotton chipping (hand weeding) and aerial spraying. These changes stemmed from changes in pest and weed management and were superimposed on losses in employment resulting from drought and from employers responding to compliance costs (OH&S, workers' entitlements etc). The fact that other factors (and technologies) cause gradual loss of employment in agriculture does not mean that losses associated with GM crops are necessarily less significant. Job loss can have compounding effects in small communities when it ripples through the community, causing further job losses in service industries and businesses. There are clearly threshholds for the survival or irrevocable decline of country towns and sudden changes in employment may trigger downward or upward spirals. Having said this, the impacts of unemployment on a rural community are complex, and depend on the nature of the employment, the sector, the timing of the change and strategies, both formal and informal, to prepare for or cope with the change. It should also be noted that there are some new employment opportunities associated with the development and use of GM cotton.

RoundupReady® cotton

To demonstrate the complex social effects of technology-related unemployment, and to evaluate these changes in relation to social sustainability, it is useful to consider the two GM crop types separately. RoundupReady® cotton has a modification that makes it resistant to the herbicide, Roundup®. This makes a new weed management regime possible. Previously, herbicides such as Roundup® could only be used before the cotton plants began growing (pre-emergence). Weed management after emergence of the crop relied on hand hoeing of weeds (cotton chipping). Cotton chipping has been a historical feature of cotton growing and provides seasonal employment for casual workers. These comprise local people, including farm women and young people seeking extra employment and underemployed members of the community; and itinerant workers, such as those on a seasonal circuit of fruit picking, international farm workers and university students. Among these, a relatively high proportion has been Aboriginal people, both local and itinerant. As well as providing work for people who may have few other employment opportunities, chipping work, together with other farm labour, has had important social and cultural roles in providing opportunities for family and friends to travel and visit together, in bringing people of different cultures together, in providing extra income for Christmas and for school enrolment at the end of summer, and in providing on-farm experience. For these rural communities generally, the influx of chippers, which at one time could be counted in their hundreds, brought commerce, business and diversity to these communities during chipping season and contributed to sustaining the towns throughout the year.

Chipping also has its downsides, however. It is hot, hard work and working conditions, including pay, have been poor in the past. Living conditions for itinerants were also very basic. More recently, OH&S and other standards have improved conditions, but this has ironically led to a reduction in the opportunities for this kind of work. Itinerant workers have also brought social

problems to country towns, including petty crime, violence, drunkenness and abuse of community services and accommodation facilities. The attitude of community members to chipping seems to depend on whether they rely on it (either directly for employment or indirectly in providing business and commerce) or not. Larger towns with secondary industries that rely less on itinerant workers to sustain them may be more negative than smaller towns. The ultimate impact of reductions in chipping work will clearly depend on the particular social setting.

Another issue with RoundupReady® cotton is the monopoly that Monsanto currently has in herbicide-tolerant cotton. While this product has reduced the use of a range of herbicides, some more toxic and persistent than Roundup®, and may have reduced the overall volume of herbicide applied to cotton crops, it has considerably increased the use of a single herbicide. This has implications for competition in agrochemical sales, and the availability of alternative products. It also raises important concerns about the development of resistance to Roundup® among weeds.

Bt cotton

Bt cotton (Ingard® and Bollgard® II), which is resistant to the primary pest of cotton, *Helicoverpa*, also allows changes in pest management. The use of this GM cotton has allowed significant reductions in the use of insecticide. As well as reducing the exposure of the environment and the community to insecticidal sprays, this has also contributed to the development of Integrated Pest Management (IPM) and Area-wide Management (AWM) in the cotton industry. The cotton industry has been under pressure to reduce sprays, because of environmental and social concerns and because of the development of resistance within insect populations to new insecticides. The industry has been developing Best Management Practices, and a number of farms have developed IPM practices and established AWM groups. AWM is a system of pest management in which neighbouring farms meet regularly and communicate about management decisions, in recognition of the effects of their actions on farms in the same area, particularly when using IPM. This allows control of insect populations on an area-wide basis. It also contributes to social cohesion and community.

It is unclear what role Bt cotton has had in the move towards IPM. At a research level, it is regarded as a key tool in sustainable pest management. It may provide an important opportunity for farmers to try IPM because they can reduce sprays and allows biodiversity to build up, including beneficials (insects and other species that prey on insect pests), without significant crop damage. However, IPM farmers seem to regard Bt cotton as just another tool among a suite of pest management strategies and use it flexibly with other approaches. Some are concerned that the wide-spread use of Bt cotton varieties will hamper the development of IPM because integrated management relies on use of a range of techniques, not on one 'silver bullet'.

The reduction in chemical pesticide applications has had an impact on the aerial spraying industry. Their work has been significantly reduced and operations have been downsized as a result. For many in the community, the benefits of reduced spraying, both in reducing exposure but also in improving the environmental credentials of the cotton industry, have outweighed this loss of employment. Aerial sprayers themselves seem philosophical about the change, and some have begun

to look for new opportunities, for example in foliar fertiliser application and ground spraying. The downsizing of aerial operations will have ramifications, however. There is a risk that secondary pests of cotton, with the primary *Helicoverpa* pests removed, will become primary pests; and a smaller risk that *Helicoverpa* will eventually develop resistance to Bt. In either case, spraying may become necessary again, and the infrastructure may not be available to meet the demand. At the same time, there are safety issues associated with reduced demand for spraying. Because there is less work early in the season when aerial sprayers fly during the day, pilots do not have the opportunity to familiarise themselves with the territory in time for summer spraying, which is done at night. In general, there are fewer young people training as pilots. Similarly, the agrochemical reselling industry has been affected by the uptake of GM cotton. While a role for resellers in managing GM technology agreements has opened up, the infrastructure for supplying ag chemicals has been affected. Farmers have had difficulty in getting hold of some chemicals, particularly late in the season.

With reductions in chemical use, GM cotton varieties are expected to save farmers money. However, the new varieties incur a technology fee, and this fee varies between different countries and even regions. In principle, this fee should reflect, to some extent, farmers' willingness to pay in choosing GM over conventional varieties, and should therefore remain equal to or below the cost of conventional management. However, with changes in the industry reflecting wide-spread adoption of the GM varieties (reduced infrastructure for agrochemical reselling and application), farmers' choices may be gradually curtailed. There is then a risk that technology fees will be increased, reducing the economic benefit to farmers. This risk is exacerbated by the current monopoly, with GM varieties available from only one company (Monsanto), although other companies are currently developing products for the industry.

Farmer choice will also be affected by the availability of conventional varieties. While research into plant improvement through breeding is important in providing adapted germplasm for introduction of GM traits, breeding work does potentially compete for research investment with biotechnology. Partnerships between technology companies, seed companies and public research organisations are a feature of the introduction of biotechnology in agriculture. This has been important in Australia in managing the introduction of GM. However, in order to protect the interests of farmers, it seems critical for public research and local seed companies to maintain their ownership, control and investment in adapted varieties for the industry. The issue of control of the technology was a significant concern to many of the participants.

A related issue is farmer choice and control in managing the new technology. GM seed also comes with a technology agreement, which dictates the conditions under which the crops can be grown. While these conditions serve to reduce risks associated with the technology (such as risks of insect resistance developing, or GM plants escaping) and are linked to regulatory requirements, they do tend to reduce the control farmers have over decision-making. This is a significant social issue in that control over the farming operation is a valued feature of farming. Making active, informed decisions is also important for integrated management and natural resource management.

Conclusions

The concept of social sustainability was found to be more valuable in bringing people to the table to discuss what *should* be sustained, rather than to measure whether sustainability had been achieved. It is not possible to say that a new technology makes a community or industry sustainable or unsustainable, particularly in social terms. However, it is possible to consider the contributions a technology makes to sustainability *directions* of an industry or community, and to assess the social impacts and benefits and how they are distributed. The study suggested that impacts and benefits are highly dependent on the social setting, and that a consideration of social *context* is therefore crucial in the social assessment of technologies.

The rapid and widespread adoption of GM cotton varieties in the Australian industry has had a range of effects and raises a number of questions in relation to sustainability. It is instructive, in evaluating the 'sustainability performance' of this technology, to consider different GM traits (in this case insect-resistance and herbicide tolerance) on a case-by-case basis. In terms of its contributions to environmental sustainability, Bt cotton seems to perform better than herbicide-resistant cotton, in reducing agrochemical use and potentially contributing to IPM. While herbicide-resistant cotton may create some opportunities for better weed management, it does not help farmers to escape the agrochemical treadmill.

Socially, both types of GM cotton cause losses of employment. On the one hand, insect-resistant cotton causes changes in pest management that reduce business in the agrochemical industry. This may cause permanent changes in infrastructure and services, as well as impacting on the community in the short term. It will have impacts on individuals and communities, depending on the ability of the aerial operators and chemical re-sellers to find new opportunities and directions. A loss of infrastructure may cause problems for the cotton industry if new pest problems emerge, but these may provide further impetus for shifts towards IPM. A further shift away from chemically-intensive agriculture would bring environmental benefits and would improve the image of the industry, potentially providing marketing advantages if niche markets can be found. It would also bring social benefits including better relations between cotton farmers and others in the community, health benefits, and increased community interaction through area-wide cooperation in integrated management.

On the other hand, changes in weed management with the use of herbicide-tolerant cotton reduce the availability of casual, seasonal employment. These changes may herald the end of an era for cotton chipping. This era may already have had its day, with changing work standards and changing employment relations in agriculture and many may see this change as a good thing. It will bring impacts, however, for individuals and families, and small communities living close to the edge in sustainability terms. While there are significant equity issues associated with this type of labour, there are also equity issues associated with its loss.

As one might expect in considering social consequences of a new technology, the picture emerging for GM cotton is a complex one, with benefits and impacts distributed unevenly across different social groups. In addition, the consequences are very much dependent on the social setting, with particular changes bringing positive effects in one community and negative effects in another.

This makes an overall assessment of the technology in social terms difficult. However, as social criteria are generally not used to determine whether a new technology will be approved for commercial use or not, the complex and contextual assessment of social effects may not be an impediment. Such assessment demonstrates that it is not the nature of the technology alone that determines its impact; the way in which it is introduced and managed is also critical to the social effects it will have. Attention to social issues could result in strategies that prepare communities for change, give them appropriate time-frames to adjust and help mitigate some of the negative aspects. The initial introduction of Bt cotton in Australia involved careful attention to ecological issues, notably the potential for resistance developing in insect populations. This led to a resistance management strategy involving caps on planting, refuges and post-harvest measures. Similar social strategies could be developed, involving consultation and education, appropriate implementation time-frames (allowing people to find new opportunities) and mitigation programs (such as employment programs for disadvantaged groups). Such strategies have the potential to not only reduce social impacts, but also to reduce social conflicts about new technology. In addition, information about social effects could inform R&D, particularly in public organisations, and could provide criteria for technology design and development that would meet the needs of the social as well as the agronomic environment.

While it may be possible to develop indicators to monitor social changes, it is unlikely that quantitative methods would capture the complexities and contingencies of social effects. This is why this project has stuck to qualitative methods. However, the study to date has effectively been a scoping study, and there is much information that could be collected, including quantitative data, to investigate specific issues further. Scoping studies are essential in determining the relevant questions to ask in further research that will provide empirical answers. It makes sense that this further research should be carried out in the context of responding to social issues in particular settings. It should also be noted that social research itself can represent a strategy for consulting and communicating with stakeholders, preparing for and mitigating impacts, and developing joint visions for the future.

Budget

Fieldwork travel and expenses	$ 3,470.00
Research materials	$ 470.00
Focus group catering	$ 900.00
Transcription	$ 2,660.00
Total	$ 7,500.00

Dissemination

Dissemination of the results of stage 1 of the project is an integral part of stage 2. The results have been presented in a seminar to the Australian Cotton CRC and further presentations to others in the cotton industry and the Cotton Catchment Communities CRC, and a seminar at the Bureau of Rural Sciences, are planned for 2006.

Information about the project was made available to local people during the study via newspaper articles:

> Study into GM cotton in Wee Waa district. Wee Waa News, Wed 21 July, 2004
>
> Study into community impact of GM cotton. Narrabri Courier, Thurs 29 July, 2004

The results of the project have been presented via two oral conference presentations:

> Bringing social priorities to technology development: a community evaluation of GM cotton in Australia, XIth conference of the Australian Agri-food Research Network, Canberra, June, 2004
>
> An empirical study of the social impacts of GM crops: implications for sustainability and technology governance, Talking Biotechnology (an international conference), Wellington, New Zealand, Dec, 2005

The project was also accepted for presentation in a special symposium (GMOs and the Future of Rural Spaces) of the Royal Geographical Society's annual conference in London in 2005, but I was unable to attend. The organisers have given me the opportunity to submit a manuscript to a special journal edition coming from the symposium, which is in preparation.

No publications have been submitted to date but I expect that at least two refereed journal articles on the research will be submitted in 2006.

Outcomes

The major outcomes of the project are expected to occur in the future. The research itself brought opportunities for stakeholders to consider and discuss issues about GM crops and the effects of their use, and also about the sustainability of their rural community generally. Feedback to the Australian Cotton CRC has given information, particularly to managers, about some of the social issues surrounding the introduction of GM cotton into the cotton industry in NSW. This may inform policy setting and new directions for cotton R&D. The new Cotton Catchment Communities CRC has a Social Program that is an important element in its future efforts, and this project will contribute to scoping research being conducted to develop this program. Stage 2 of the project, which is yet to be completed, will also give opportunities for other key players in the introduction of GM cotton to consider information about social consequences, which may inform their future decision-making.

It is hoped that this project may provide a model for the investigation of other current and future applications of gene technology in agricultural industries. Few such studies have been conducted internationally, and while much research has been devoted to considering the opinions, perceptions and choices of the 'general' public in relation to gene technology, particularly its future applications, little empirical research has investigated the effects of the technology on members of the public who are directly affected by it in the present. The research will contribute to the development of a broader framework for technology assessment (as described in Materials & Methods). The translation of present studies such as the one reported here to more predictive or anticipatory studies of future applications will be one of the challenges of the research. I believe that a quite similar approach might be used, beginning with an assessment of the current social context and the current values and concerns of communities. A shift in emphasis from the technology itself to the social context might signal a shift from communities having to respond and adapt to new technologies, to new technologies being adapted and managed to meet the social (as well as economic and environmental) needs of communities. It should also be noted that discussions about technology before it is introduced change the social setting, potentially making it more amenable and more able to accommodate and benefit from the technology.