IMPROVING THE EFFECTIVENESS OF RESEARCH AND EXTENSION BY EVALUATING A SITUATION HOLISTICALLY BEFORE ACTING: A CASE STUDY

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ABSTRACT

Potato production is becoming more popular with small farmers due to its immediate household food security and cash crop potential. The study considers the production of potatoes in a communal project in a high potential potato production area in South Africa. At first glance, an appraisal of the project shows how much effort the extension officer put into obtaining the correct planting material and following the research prescribed production guidelines. Consequently, most researchers and extensionists would score this project very high in terms of competency and project potential. However, this is unfounded if one looks deeper and at the broader picture, beyond simply adhering to technical practice. A socio-economic study of smallholder potato producers strongly suggests that the adoption rather than adaptation of research station recommended technical practices could result in inadvertent and sometimes detrimental consequences for the well-being of rural households. Despite the practices being in line with those recommended by the local research station, the socio-economic circumstances of the villagers were such that strict adherence to these practices was inappropriate for most of the households involved. This study highlights the need to jointly understand the socio-economic and the agroecological resource situation, before making technical recommendations. Despite popular practice, recommendations based on research station 'recipes' are not necessarily suitable for all potato producers in South Africa. Socio-economic and agroecological conditions determine suitability of such guidelines and associated practices. This study highlights the need for greater cooperation between natural and social science agricultural development practitioners, with optimal collaboration amongst research, extension and farmers.

1. INTRODUCTION

Potato production in South Africa is becoming more prominent with smallholder farmers due to its potential to provide for immediate household food security and as a cash crop. Increased interest is leading to the provision of production information and requirements, based exclusively on 'by the book' research station trials, without consideration of the possible effects of these recommendations on resource poor smallholder households. Most

smallholder farmers, especially those residing in the drier and drought prone areas of South Africa, produce crops for household consumption and, where feasible, attempt to sell any surplus that they make to local markets. Not only are they resident in agroecological zones that differ remarkably from those in which research stations conduct their trials, but the socio-economic circumstances of these smallholders also differ significantly. Given a choice it is possible that they would want more zone and circumstance specific information.

Surveys of smallholder farmers in Peru revealed that farmers preferred alternative agricultural practices, such as agro-ecology, because they optimised labour usage, capital and the use of scarce resources and were accessible even to the poorest farmers (Altieri, Rosset & Thrupp 1998). Unfortunately, most policy makers normally overlook these factors regarding the nature of farmers' circumstances and associated decision-making. They are also ignored by agricultural researchers (be they economists, agronomists, geneticists or sociologists) and extension officers when developing or introducing technology in support of broader policy ideals.

The case study provided here illustrates that in South Africa the situation is much the same with research making general recommendations about potato production which extension applies with smallholders engaged in community projects. This is despite differing socio-economic and agroecological conditions found in different locations. When technology is transferred this is largely based on the model used for neighbouring large-scale commercial farmers. The results of such practices have serious implications for the professional conduct of South African extensionists and researchers.

2. METHODOLOGY

The example reported here is extracted from a larger study, during 2006, which focused on the socio-economic and technical aspects of smallholder potato production. That study took place in three South African provinces where potato production potential is high. The differences between the five case study villages were ascribed to climate and official extension support. The village reported here was acknowledged for its high level of official extension support. Provincial extension services were asked to help identify and administer a questionnaire to ten potato producers in the village. These ten respondents came from a communal potato project and while the data presented here gives a good idea of the conditions and experiences of these communal project farmers it is not representative of the other village farmers not involved in this project. The questionnaire consisted of seven main themes: Demographics, Livelihoods[1], Social and Agricultural Support

[1] In terms of livelihoods, income and expenditure are always difficult variables to determine. This is made more problematic for households involved in this sector of agriculture. Even those that had records often did not have complete records or occasionally misrepresented their income and expenses for various personal reasons. Consequently we relied on the figures presented to us from memory and also those which respondents were willing to

Services, Past and Present Land Access and Use, Potato Production, Potato Production and Storage Problems and Desired Characteristics of a Potato Variety. Respondents were also shown photographs of 23 pests. They were asked to identify which of the pests they experienced as problems with regard to potato production, table potato storage and seed potato storage. Predominantly questions sought quantitative data and were closed-ended, but a number of open-ended questions were included to provide qualitative data and clarity to the closed responses. Further qualitative data was collected before and after the interview process in a more informal manner and was thematically analysed. Quantitative data was analysed using SPSS v.14 for Microsoft Windows.

3. THE COMMUNITY POTATO PROJECT

The case study concerns potato production in an extension initiated and driven community project in a high potential potato production area. The terrain is undulating with some hills, but the soils are quite deep and relatively fertile. The climate is cool with cold winters and moderate summers. Rainfall takes the form of infrequent thunderstorms and days of light drizzle. There are times when there is no rainfall for extended periods. On other occasions, when the rainfall is excessive, late blight, flooding and water logging can be problems. The village is situated close to the South African border with a neighbouring country. The nearest South African town is approximately 60kms away from the village. The main means of public transport to this town is by mini-bus taxi and the costs are high. The ownership of private motor vehicles in the village is scarce. The nearest seed and other inputs supplier is a farmer cooperative situated in this town.

In an effort to help farmers produce crops for additional income, a farmer group was formed to work the communal land made available at the local primary school. This communal garden is fenced, thus addressing the problem of untended and roaming livestock in the area. The group was formed in 2001 by interested farmers and is currently headed by a female chairperson and treasurer. The project started as an exotic vegetable garden but two consecutive years of poor harvest due to insufficient rain, led to the group deciding to plant potatoes, another high value cash crop but a little less sensitive to dry spells. The potato project was in its third year of production. In some cases limited production of other crops takes place in the project. Potatoes are only planted during the summer rainfall season. Like many marginal rural areas in South Africa crops rely on rainfall, as no irrigation is available.

The group size is variable – turnover is dependent on membership interest and age. Currently there are 25 members, both male and female. Sharing of tools is very limited, as most farmers received a starter pack from the local

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disclose. Therefore, all figures and subsequent analyses relating to these two variables presented here are a guide and indicate likely trends.

extension office. Project members share the costs of hiring a tractor for ploughing and soil preparation. From the qualitative discussions the impression was that the farmer group remained together in order to access extension support and access an extra area of land for agricultural activities. Their home gardens are small and as with many other rural villages, extension does not provide direct support for home garden activities (Hart and Vorster 2006). The formal structure of the community project provides an officially recognised entry point for extension.

Based on the results of soil samples and the climate in the project area the local extension officer went to great lengths to obtain suitable planting material and use the prescribed production methods. Contact with the local research station recommended the use of the potato cultivar BP1. This is also the only cultivar available commercially as certified seed in the area. Extension does not adapt the research guidelines during training but transfers these unchanged, even though all of the farmers involved are not in the same resource category as those for whom the guidelines were developed. High external input use is encouraged with this training. Very limited pest and disease management training is provided. This is probably due to the lack of knowledge about this specific subject, as it is a complex and specialised field. No collaboration with specialists has been attempted.

The members of the communal project purchase their planting material and research recommended agrochemical inputs, such as fertilisers and pesticides, through an arrangement they have with the local extensionist. Most inputs were unavailable in the local area and had to be bought from the nearest town 60km away. This increased the costs of the inputs. In the community project most of the decision-making and buying was done on an individual basis. Even the purchase of research recommended inputs was done on an individual basis. The reason for this individuality is unclear but it seems that not all the members wanted all the inputs and that others wanted different types of inputs. Individuals are also responsible for their own sales. Other villagers come to the project when they know that harvesting is taking place. Occasionally, unsold produce is taken home and sold from there. Some of the produce is stored for seed and some for household consumption.

Most of the project members reported that they were now harvesting more than previously. Reasons for this are attributed to the following aspects that occurred during the previous five years:

- Increased access to land (Project plot size was an average of 1274m^2 per member ;
- Basic tools received from starter packs;
- Presence of extension supported projects (poultry and community garden);
- Involvement in agriculture where previously they had no involvement.

Farmers also pointed out that agricultural production in the area had generally increased during the previous five years due to higher unemployment forcing people to engage in greater crop production, such as

increased planting of maize. Recent favourable rainfall patterns also encouraged people to increase cropping and keeping of livestock. Extension is only involved at the project site and not in the household gardens. All the project members have different agricultural practices at home than at the project site. The extension advice and training seems to be limited to the soil preparation and planting stages of potato cultivation. Consequently, it cannot be argued that extension has contributed sufficiently to the overall increase in agriculture.

There seems to be a strong reliance on the extension presence amongst the project members. Farmers feel compelled to remain members of the community project in order to retain access to extra land, inputs and training. The adherence to the training, at the project site, and high input messages seems to be the price the farmers need to pay to ensure continued access, thus questioning the sustainability of the relationship and the agricultural project. The fact that all the farmers use low input technologies in their home gardens seems to support these concerns. An understanding of the agroecological and socio-economic dimensions surrounding the project provide further evidence questioning the sustainability of the project and any possibility of farmers increasing potato production.

4. AGROECOLOGICAL AND ENVIRONMENTAL SITUATION

Initially it seems that the extension services have taken steps to ensure that the possible agroecological diversity of this area does not pose a problem to potato production. As a first step soil samples were taken and the local research station – approximately 60kms from the project site - identified the planting material, cultivar BP1. This research station also recommended suitable fertilisers for soil preparation. However, from this point onwards communication, or the extension, of any further potato production knowledge broke down. Farmers in this project were not advised about soil health and correct crop rotation patterns, pest and disease control, and no strategies were considered for water management and associated problems.

4.1 Soil Health and Crop Rotation Patterns

Farmers' were asked to indicate what they had planted in the two preceding planting seasons on the land where they had most recently planted potatoes. Reporting of more than two previous crop cycles on a specific field was found to be unreliable in previous fieldwork done by the ARC, as most farmers do not keep field planting histories. In an effort to get some idea of the rotation practices it was limited to these two cycles, as it tends to identify rotation with solanaceous and other unsuitable crops. Due to different farming patterns the respondents indicated the following individual crop rotation patterns.

Table 1: Recent Crop Rotation

Current Season	Previous season	Season before previous season
Potatoes	Beans	Potatoes
Potatoes	Beans	Potatoes

Potatoes	Maize	Potatoes
Potatoes	Maize	Potatoes
Potatoes	Variety of vegetables	Variety of vegetables
Potatoes	Maize	Beans
Potatoes	Variety of vegetables	Variety of vegetables
Potatoes	Maize	Potatoes
Potatoes	Maize	Potatoes
Potatoes	Maize	Beans

The extensionist had been unable to provide any information on crop rotation. The crop rotation here is poor and not suited to potatoes. It needs to take the farmers' requirements, especially preferred crops, into consideration, as well as the specific environment in which they farm. Making use of brassicas to help control nematodes (ranked as one of the top five pests) and not planting host crops is very important – even more so when the socio-economic situation does not encourage more costly methods of control. Maize and beans are host plants for nematodes, thus increasing the problem in the area. These plants are, however, important primary food crops in the area and cannot be ignored. Planting brassicas between these susceptible crops in the rotation cycle might help to control the nematode population to some degree. Ensuring that no other solanaceous plants are incorporated into the cycle is also very important. A four-year crop rotation cycle is seen as the best in most cases. Of course, in the current situation of extremely small parcels of land and the project management structure such a long cycle needs careful consideration. With creativity, this may be accomplished in the following manner:

- These farmers need to get help from a knowledgeable potato production specialist who, in collaboration with them, would help them establish the best rotation practices for their circumstances.
- Combining their fields in the community project to establish a longer rotation cycle might also be an option.

This project is still relatively new, and developing an effective crop rotation now could help to prevent the further build-up of any soil-borne pests and diseases. What is of concern here is that neither extension nor research seem to have attempted the promotion of suitable rotation patterns based on the local food crops.

4.2 Pest and Disease Management

The research station recommended the cultivar BP1 as the appropriate certified planting material due to its local demand and popularity amongst large-scale producers. While the cultivar Mnandi was developed specifically for smallholder farmers and considers some of their circumstances, it is not available in this province. As we shall see it might well be the better choice of cultivar. While all respondents reported purchasing certified BP1 potato seed from the cooperative or extension services eight also reported selecting, storing and replanting potatoes from the previous season. This was more common at the home gardens, as extension encouraged the use of certified seed in the community garden to ensure that pests and diseases are not

introduced into the soil[2]. However, three farmers reported introducing BP1 potatoes, purchased at supermarkets, amongst their certified seed at the community project. The reason for this is that these tubers are cheaper than certified seed. Prior to the study extension was unaware of this practice. If certified and uncertified seed is planted in the same fields, the effectiveness of buying certified seed is questionable, especially if the uncertified seed are infected with soil-borne diseases. Primary infection of certified seed from uncertified sources, via aphids and thrips, does not necessarily affect the yield. But, if seed is kept from these sources, the yield from that crop will be decreased. When uncertified seed is used soil-borne diseases, such as bacterial wilt, nematodes and common scab can infect the soils. The chances for infection from certified seed are small. Water movement within soil can also move serious diseases such as bacterial wilt from one area to another. In this area, where heavy rainfall is experienced, this is a reality farmers face. While only three respondents acknowledged introducing uncertified seed, due to the small areas planted, diseases can be spread through the whole project area. Storage of seed for later replanting is common practice amongst rural households and is something that extension and research need to take note.

The most frequently mentioned general potato production problems were listed as millipedes, moles, cutworm and input costs. Specific pest production problems included moles, millipedes, cutworm, nematodes and rodents. Advice on IPM might reduce these pest problems and also the nematode problem. The most frequently mentioned pest storage problem was rodents that ate the potato tubers. Adjusting the method of storage and putting out traps might help to reduce these losses. Extension officials were unaware of the fact that millipedes, cutworm and nematodes were problems. Many of the infected tubers are removed during harvesting and therefore these problems need to be identified during regular monitoring exercises during the production cycle.

Many of the farmers and the extensionists cannot identify the pests and diseases that occur on the crops, making effective pest and disease control difficult. This, questions the buying of agro-chemicals to control pests and diseases as reported by the group.

4.3 Water Management Issues

These are divided into two types. Firstly, there are times when there is too much water as a result of excessive rainfall and secondly, when there is not enough water due to prolonged dry spells.

Late blight is a very weather specific potato disease, as it requires cool and wet conditions to develop. When high levels of rainfall occur conditions are created whereby late blight can become a problem. A cultivar such as Mnandi would be more suitable than BP1 in such cases as Mnandi has field resistance against late blight. The high rainfall can also cause growth spurts that can lead to hollow heart formation in tubers due to the fast growth rate. Again a

[2] Extension has no involvement in the activities that take place at rural households, even where household members are members of this project

cultivar such as Mnandi might help solve the problem, as BP1 is more prone to develop hollow heart. However, as noted earlier BP1 is the only certified cultivar commercially available in this area.
Other strategies for managing excessive water can include short, non-planted areas in rows that can be opened when water logging is expected due to extended periods of rainfall. This will enable water to flow out of the fields. By shifting the location of this area between rows soil erosion will be minimised and these areas can be hilled again when the danger of water logging has passed.
Rainwater harvesting and storage at home can enable the production of drought sensitive plants such as exotic vegetables, thus increasing diversity in food gardens. Mulching, cover crops, trench gardens, conservation tillage and other means of water retention could also be used to ensure crops get sufficient water during dry-spells. Such strategies are low external input technologies (LEIT) and typically reduce the financial costs associated with reliance on high external input technologies but are often initially labour intensive.

The agroecological situation is such that crop failure for potatoes and other exotic crops, requiring high volumes of external inputs, is high. As we shall see the socio-economic circumstances compound this situation. Local extension and research need to familiarise themselves with LEI technologies so that they can assist farmers with adapting them where appropriate.

5. THE SOCIO-ECONOMIC SITUATION

5.1 Household size and dependents

Half of the households are female headed (see Table 2), with many male members migrating to the city for employment. This and the fact that only two farmers were full-time farmers suggests that agriculture is generally practised as an extra livelihood. Women tended to do most of the farming activities, with men (where applicable) determining what the women must do in their absence. The mean size of the households was 7.9 members and 70% of households had between 4 and 7 members. One-third of the households support their own children as well as their orphaned grandchildren, thus increasing their household size to between 11 and 14 members. Large household sizes, especially where dependents are young, inhibit people from spending money on expensive inputs. They need to get maximum return from minimal expense.

Table 2: Household Demographic Data

Number of households	Number of HHs without permanent worker	Number of male-headed HHs	Number of female-headed HHs	Number of pensioner-headed HHs	Average age of HH heads (years)
10	5	5	5	1	52.1

5.2 Household income and expenses

Despite half the households not having a member with permanent employment (see Table 2), income from non-agricultural activities is greater

than income derived from agricultural activities. The mean annual income (R17 488) is low and one household was reported as living below US$ 1 per day. Social support grants (SSGs), in the form of pensions and child support grants contributed on average to more than half (55.7%) the monthly income of the nine households that accessed at least one of these grants. The total annual income per household ranged from R2 680[3] to R33 260 with a mean of R17 488. When this is placed into context with the average household size of 7.9 persons per household (just over R6 p.p.p.d.), it emphasises the need for agricultural practices, such as LEIT, which will reduce the input costs required by households. Where older children, who had occasional employment, still lived at home they did not contribute cash to the household. Sons generally contributed nothing to the household while daughters would occasionally provide groceries. Despite using household resources they did not contribute regularly to household needs.

5.3 Agricultural income and expenses

Most of the farmers stated that agriculture has become more important as a food source in the last five years. Some stated that agriculture has increased in significance as a source of income due to their access to land and inputs, which they get as members of the community project. Extension has stopped with the initial handouts and project members now need to provide for their own agricultural inputs. Members now complain that the input costs have become very high – initially they were free! The average household expenditure on inputs in this village was 12.5% of household income while the average contribution made by agriculture to household income was 6.7%. The mean annual income from crop sales was reported as R438. High expenditure on inputs is due to the high input message emphasised by extension. Table 3 indicates that most of the households are getting a lower percentage return on their investment of household income in agricultural activities with only three actually getting an equal or greater return on investment. This is a result of households using the inputs ineffectively due to the high cost and inability to afford the required volumes. The inability of farmers to quantify what they consumed may also explain some of the poor returns.

Table 3: Percentage of household income spent on agricultural inputs and the percentage contribution of agriculture to household income

Respondent HH	Annual HH input expenditure in ZAR	% Income spent on agricultural inputs	% Contribution of agriculture to HH income
1	744	5.99%	3.38%
2	1266	3.81%	1.50%
3	980	3.15%	5.46%
4	2565	24.22%	6.89%
5	778	4.22%	8.68%
6	1160	5.14%	2.22%
7	66	2.46%	0.00%
8	1330	6.47%	7.21%
9	5325	59.43%	26.03%
10	1355	9.48%	5.95%

[3] At the time of the study in 2006 this amount was less than $US 1 per day.

In this particular area the agroecology is such that diseases and crop failure are a reality. This is further compounded by the socio-economic circumstances of the local residents that prevent them from purchasing sufficient volumes of external inputs to reduce risks. While the average percentage expenditure on agricultural inputs is relatively high, it is insufficient to prevent crop failure in most cases, making the return on investments low and in most cases less than the expenditure.

6. IMPROVING EXTENSION EFFICIENCY

The small amount of time spent on agricultural activities (on average about 23 hours per week), the high number of dependents and the low income of most of these households is an indication for the need to shift to agricultural practices that incur a lower financial cost and risk. The relatively high percentage of income spent on inputs by such a poor group in a fairly unsuitable agroecological environment is problematic, as an economic shock caused by crop failure will have far reaching effects on household food security. Shifting to low external input agriculture would help to lower the financial risks of these households, and could increase the returns from agriculture. Currently farmers are practising such practices at in their home gardens. As farmers become more familiar with the production principles of potatoes, those who are so inclined could then make the choice to adopt practices that might increase their risk, but also possibly their return. The current introduction of potatoes, and this particular cultivar, is questionable as this is a high-risk crop. A local market survey could help to identify crops that might be of lower risk but still have an income generating potential. A better understanding of the agroecological situation would also facilitate this process and ensure more appropriate crops and cultivars.

Providing training to both extension and farmers that emphasises understanding the cultivation principles, rather than a recipe, may enable both groups to identify and adapt suitable technologies to local circumstances. Technologies and crops used should take the farmer's circumstances into consideration, as other demands on their time, capabilities and resources should be compatible. Understanding principles may enable high input agricultural practices to be adapted to help the farmers realise a higher return on their investment by judiciously using low external input technologies where possible. Switching to low cost technologies such as manure, composting, trench gardens, etc., could increase returns and enable farmers to buy some much-needed inputs or address other household requirements. Using services such as mechanised ploughing optimises the use of household labour and lessens the hard work of clearing and preparing fields, thus enabling women to continue with other chores. Ignoring the gender issues involved in agriculture can lead to further marginalisation of this group.

The high involvement of extension in the accessing of inputs does relieve the transport costs for the farmers to some degree. However, because these inputs are insufficiently used this practice is questionable. The supply of starter packs that include basic hand tools (such as spades, hoes, forks, rakes and

watering cans), seed and fertilisers are a great help to poor people who cannot afford to purchase these implements and inputs. However, this was a once-off event and could have been strengthened by introducing appropriate LEI technologies rather than costly external inputs.

7. CONCLUSION

Extension provides a very limited service in terms of potato production. While some knowledge is lacking, seemingly not provided by the research station, the extentionists seem to have no idea or means of obtaining further knowledge and sharing this with the farmers. The information provided by the particular research station is also questionable as it is exclusively based on the demands of the large-scale farming sector. Even here the provided information seems incomplete as the extensionists lacked important knowledge on pest and diseases and crop rotation. As a result extension activities are limited to providing services that might not have been required in the first place, such as purchasing various inputs, which are not used effectively due to the socio-economic circumstances of the project members.

Extension personnel should know alternatives to the high external input practices. This can be accomplished by contacting the appropriate research institutions on a regular basis, as well as reading applicable literature about the crops and associated technologies. However, a prerequisite is that extension personnel understand the various principles of crop cultivation and management.

If extension officials understood the principles underlying the production and management of potatoes this would allow them to manage and control for the technical problems we have outlined. By merely following some research recipes and not the principles, they are unable to adapt practices to the different socio-economic and agroecological circumstances that they encounter. For example they could help farmers reduce costs by considering low external input technologies and by helping them to use alternative planting material (botanical seed) and accessing cultivars that are more appropriate to local socio-economic and agroecological conditions.

Extension and research needs to be trained to observe and understand socio-economic and agroecological phenomena and base their recommendations and services on these rather than on research station advice alone. In essence it is the lack of understanding of the agroecological environment and the socio-economic circumstances that have prevented them, in this instance, from providing an appropriate agricultural development project. Given the socio-economic and agroecological situation in the area it makes more sense for the extension services to consider a less risky crop or at least more suitable cultivar and the use of appropriate low cost and low external input technologies.

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REFERENCES

ALTIERI, M.A., ROSSET, P. & THRUPP, L.A. 1998. The Potential of Agroecology to Combat Hunger in the Developing World. *2020 Brief 55*, October 1998. Washington DC: International Food Policy Research Institute.

HART, TGB AND VORSTER HJ. 2006. The Importance of Indigenous Knowledge in Reducing Poverty of Rural Agrarian Households. Research report for the National Indigenous Knowledge Systems Office of the South African Department of Science and Technology.