Matching Natural Resource Management Technologies with Potential End Users: A Knowledge Engineering Approach[1]

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Introduction

The new technologies generated by agricultural research have undoubtedly made a major contribution to the development of rural areas over the last four decades. Today, however, public-sector budgets are subject to growing pressure while policy makers increasingly expect the research that they support to contribute to a broad range of social and environmental objectives. The task of setting research priorities has therefore grown in both importance and complexity, as research managers allocate limited resources to address an expanded range of policy objectives and client needs.

Priority setting is carried out explicitly or implicitly in all research programmes through the allocation of research resources to different activities. A variety of models and approaches are available to guide and inform such decisions: agricultural research priorities may be defined in relation to crops or commodities, regions, types of technologies, socio-economic characteristics of potential users, and in many other ways. As Byerlee (2000) points out, agricultural research priorities are set at various levels, most commonly at the national, programme, sub-programme and project levels. Resource allocation questions vary depending on the level at which priorities are set. Table 1 (reproduced from Byerlee *op. cit.*) shows the types

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of decisions typically made at each of these levels. He notes that priority-setting at the lower levels of this hierarchy, particularly about the types of technologies to be developed and their specific characteristics, offers the greatest potential to increase the probability that defined groups of farmers will immediately make use of research results. Decisions made at these levels will therefore take on increased significance in the current policy environment. And, as development policy has increasingly focused on the poor, on women and on other vulnerable groups within society (such as those living in low potential areas), it has become more common to use the socio-economic characteristics of potential users (of agricultural technology) to prioritise agricultural research.

The decision to set research priorities on the basis of the socio-economic characteristics of the potential users of the research outputs can only be seen as a first step, since it says nothing about how those priorities should be addressed. The next step is to target technology development towards the groups in society that are of greatest relevance to policy objectives. While the idea of such targeting has been discussed at length,[3] research managers still lack practical tools that would enable them to target technology development in a systematic manner. In particular, when faced with a range of proposed research projects competing for limited resources, they need some means of identifying those projects that are likely to have the greatest impact upon the policy relevant groups. In other words, they need a method to select those proposed new technologies whose characteristics ‘match’ the interests of, and the resources available to, the groups that have been prioritised by policy-makers.

The present paper therefore describes a method for assessing technology development proposals (and hence alternative research investments) in the light of their likely policy relevant impact. In order to do so, descriptions of proposed new technologies are compared with information about the interests of, resources

[3] For a recent review of the literature on targeting technology development towards women, see Doss (2001).

available to, and locational characteristics of different groups of potential users. This method has been formalised as a decision support system for researchers and research managers. This computer-based decision support system, *Interface*, was developed for the southern part of Ghana at the forest-agriculture interface. The system has initially been ‘populated’ with data relating to this part of Ghana, but we believe that the concepts and techniques described in this article could be applied to virtually any rural area of the developing world with only minor modifications.

This remainder of this article begins with a brief review of the essential concepts that were presented in earlier papers. Based on these concepts the process of matching proposed technologies to the interests and resources of defined groups of potential users is described. This process is then illustrated with several examples of technologies typical of southern Ghana. In the final section of the paper necessary steps in the further development of this approach are considered.

Background concepts

First we need to acknowledge that the conditions under which agriculture is practised vary widely across different regions of the world. Such diversity is particularly marked in the regions of low-input agriculture, which means that the technological needs of the people who live and work here are highly heterogeneous. Therefore, there is no possibility of developing a single technology that would be appropriate for more than a minority of the population of these areas: different people farm in different ways and so may require different technologies. Nor would it be feasible to develop a range of technologies that would be sufficiently broad to meet the diverse requirements of all users: the resources available for agricultural research and technology development for poor people are limited, so that only a narrow range of priorities can be addressed.

Research managers seeking to target technology development for the inhabitants of these areas must first, therefore, define groups of prospective users who are *likely* to respond in the same way to a new technology. They then need to estimate how many people belong to each of these groups, or *market segments*, in order to decide whether the cost of developing a technology for them can be justified. The range of farming environments and strategies makes it impossible to provide a simple way of classifying farmers for this purpose, although farm size and production environment have often been used as parameters for targeting technology (Tripp 2001). Both of these categories require further analysis before they can provide a reliable basis for targeting technology, although they do correspond to the two dimensions in which agricultural diversity is apparent: the physical (soils, rainfall) and the social-economic environments within which farmers live and work.

We note first that the size of the farm operated by an individual, in itself, says little or nothing about the technology required by that person and is therefore of little value for targeting research. *Relative* farm size, however, may serve to indicate an individual's position in society, and this in turn will strongly influence their ability to gain access to the various resources such as land, labour, capital and information that are required for farming. At the same time, diversity within the physical environment will impose variable limits in terms of resource quality and availability. Variation in both of these dimensions thus gives rise to the high diversity of farming systems (and of livelihoods) with which research managers must contend.

Since the object of targeting is to generate technologies whose characteristics are appropriate for the groups to be assisted, research managers require a framework to describe *both* the technological needs of rural people *and* the characteristics of proposed new technologies. In our most recent paper (Reece, Sumberg and Pommier 2002) we proposed such a framework. For this purpose we regard any technology as being a bundle of 'benefits' accruing to whoever uses it and of 'resources' that are required to use it. Our framework is, at present, applicable only to new technologies that represent incremental improvements to those that are used at present. Thus, we can describe both the benefits and the resource requirements associated with a new technology by comparing it with current practice, e.g. 'grows faster', 'tastes better', 'requires less weeding'. For example, a soil conservation technology might deliver the benefit 'increased land productivity' but at the cost of different resource requirements, such as 'more labour' and 'more purchased inputs'.

Such a package of benefits and requirements would be useful to, and within the reach of, some people but not others. Our framework consists of a simple set of ‘generic’ benefits and requirements defined in this way.

In order to use this framework to describe the technological needs of defined groups of people, it is first necessary to establish relationships between a person’s position within society and the ‘generic’ characteristics of agricultural technologies that make them suitable or unsuitable for that person to use. We have therefore developed a method that does so on the basis of expert judgements made by a panel of social scientists familiar with agricultural practice in the region of interest. Our method thus depends upon the basic knowledge about social relations and the relations of production (and their implications for the manner in which livelihoods may be constructed) that they have accumulated over years of conducting social research. Their informed opinions are used to establish a set of simple relationships between a limited number of key socio-economic variables and some generic characteristics of all agricultural technologies: the additional benefits accruing to their users and the additional resources required to use them effectively. The computer is then used to combine these simple relationships and so to develop composite profiles of different social groups in terms of the interests of and resources available to their members. These profiles then provide the basis for consolidating groups with similar profiles together into a limited number of clusters, each of which may be treated as a market segment. The demographic information that is also held within *Interface*, the decision support system, is then used to provide estimates of the numbers of people belonging to each such market segment.

This section has briefly reviewed a method to define groups of people within rural society who are *likely* to respond in the same way to a new technology, and to estimate how many people belong to each such group. Such estimates would, in principle, make it possible to decide whether the cost of developing a technology for any particular group could be justified. However, before identifying the various technologies that are likely to be accepted by most of the members of each market segment, we need to consider the context within which such technologies will be used. The immediate context, of course, is provided by a farming system, itself situated within a specific geographical region. Reece & Sumberg (2002) have suggested that farming systems are characterised by their level of 'precision', which reflects farmers' abilities to implement their decisions or plans. These abilities in turn are a product of their ability to exert effective control over key aspects of the farming system. Farming systems where farmers exercise relatively little control can be termed *low precision* systems, and those where they exercise more control *high precision* systems.

Now, our analysis is based on the assumption that the precision of a farming system is a simple function of the farmer's capacity to obtain additional resources.[4] The 'scores' given by the expert panel may thus be used to obtain estimates of this precision for farmers belonging to each of the social groups. The simplest such estimate, which the decision support system currently uses, is just the average capacity of a farmer to gain access to additional resources. We thus regard the precision with which an individual farms as reflecting that person's position within society.

Farming systems, of course, are located within geographical regions, each of which may exhibit distinct physical and socio-economic features. Since different technologies are suitable for use in different regions, the technological needs of rural people depend not only upon their position within society but also upon the location of their farms. Production environments may differ from each other in at least two dimensions: physical parameters (rainfall, agricultural potential), and socio-economic characteristics. In principle, the physical environment that each such region represents may be characterised in terms of its soil type, temperature, rainfall or

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[4] This approach is reasonable, since a farmer's ability to gain access to (additional) resources is, clearly, closely related to her/his control over such resources.

humidity level. At present our system makes use only of rainfall levels, and holds information on the average annual rainfall for each district of Ghana.[5]

At the same time, we characterise each region in socio-economic terms by using the concept of 'agricultural logic', which we use to denote the production context that prevails there. The basic idea underlying this characterisation is that increased pressure on land resources and increased market access create a logic of intensification, while in the absence of such pressures the logic is one of extensification. In some areas, however, an intermediate logic prevails. Following the work of Snrech (1995) and Wiggins (2000), we see the agricultural logic of a district as depending upon its rural population density and its access to urban markets. Such market access is in turn dependent upon the distance from the district in question to a reasonable road and the strength of the 'pull' exerted by the urban market, while this urban market 'pull' itself depends upon the size and proximity of the urban population. The decision support system uses these ideas to classify an array of geographical areas in terms of agricultural logic. The agricultural logic of each district is thus held along with data on rainfall and population.[6]

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[5] For the Ghana example, estimates of mean rainfall were derived from a rainfall data set for the period 1961-1990, held within the Data Distribution Centre for the Intergovernmental Panel on Climate Change (IPCC), which is housed at the Climatic Research Unit of the University of East Anglia. Using this data a GIS was used to estimate average annual rainfall for all areas of Ghana and a set of district-level averages was computed.

[6] Our approach may be compared with the recent work presented by Wiggins and Proctor (2001). Rather than separating the physical and socio-economic characteristics of rural areas, they combine these to produce a taxonomy that distinguishes five different kinds of rural environment: peri-urban zones; 'middle' countryside, where distance from the city prevents daily commuting and the cost of movement to and from the city is significantly greater than for peri-urban zones; and 'remote' areas, cut off from the city by lack of infrastructure, great distance and physical obstacles. While the quality of the natural resource base is not important in

Matching people with proposed new technologies

Having identified and described the market segments and characterised the different environments within which their members work, we are now in a position to match proposed new technologies with the people likely to use them. The general approach to this is outlined in Table 2, where five characteristics of a proposed new technology must be matched with characteristics of potential users and their geographical areas and farming systems. This process of matching is described in more detail in the remainder of this section.

Describing new technologies

A critical element of the matching process is the description of the proposed new technology, which we anticipate will be provided by the researchers who have proposed its development. The first two elements of this description, the benefits and the resource requirements associated with the new technology, must be specified by comparing it with current practice using the framework outlined above. But the description requires an additional three elements: (i) the 'solution space' of the technology (see below); (ii) the physical environment within which the technology will operate effectively; and (iii) the 'agricultural logic' of the technology (see below). It is clear that when the technologies that are being described have not yet been fully developed this kind of description will necessarily be both approximate and speculative.

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the peri-urban zones, the development possibilities open to areas of 'middle' and 'remote' countryside differ markedly depending upon whether they have good or poor natural resources. The technological needs of the people living within each of these five kinds of rural environment will, of course, be different.

The degree to which a proposed new technology is likely to tolerate less than optimal management, as measured by its expected solution space,[7] is an important element of its description. In order to estimate this, researchers who propose to develop a new technology must identify the key management variables (KMVs) that determine whether or not it will produce an acceptable result (for a new crop variety these might include factors such as planting date and quantity of fertiliser applied). Next, the researchers must estimate the degree of flexibility in each KMV that the technology allows if it is still to give acceptable results. Different KMVs may well exhibit varying degrees of flexibility: a new hybrid maize variety (for example) may tolerate considerable variation around the planting date, but yields may be severely reduced with even small reductions in fertiliser application. After considering the degree to which each of the KMVs is flexible, the researcher should be able to estimate the overall solution space of the technology, which measures its overall flexibility.

Another dimension in which the new technology should be described is the range of physical environments within which it is likely to function effectively. In principle, this range of environments could be defined in terms of the soil types, temperatures, rainfall or humidity levels that the technology can tolerate. At present, however, we only use the range of annual rainfall levels within which the technology is expected to give satisfactory results. Thus, the description of a proposed new technology

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[7] Reece and Sumberg [2001] use the term solution space ‘to denote the “area” around an optimal set of operator-influenced conditions within which a technology will still yield “positive” results’. A solution space, then, is all combinations of values of critical management variables that deliver positive results when a particular technology is used within a given environment. Different technologies will have different solution spaces which may be larger or smaller than each other, with the ‘size’ of a solution space referring to the technology’s ability to deliver positive (if perhaps sub-maximal) results as the operator-influenced conditions move further and further from the optimal set.

includes the minimum and maximum rainfall levels between which it is likely to perform satisfactorily.

The final characteristic of a new technology is what we refer to as its ‘agricultural logic’. As explained above, we apply this term to an area or region to denote the production context that prevails there. However, we may also use this term to describe an agricultural technology whose use would be appropriate in a given production context. For example, we describe a technology that would be appropriate for a region undergoing agricultural intensification as itself having a logic of intensification. More generally, we say that the logic of a technology refers both to the production context for which the technology would be appropriate and to the kind of development (or resource use) trajectory that it would advance. Since many technologies may be useful in more than one production context, we can describe a technology by stating the ‘logic range’ within which its use would make sense (for example extensification-intensification, or extensification-intermediate or even intensification-intensification).

The matching process

Given a description of a proposed new technology, the decision support system identifies those potential users whose characteristics match those of the technology in all of the five dimensions that have been outlined. It first selects those social groups whose members are *both* (i) likely to be interested in the additional benefits that will accrue to users of the new technology and (ii) in a position to make use of it, i.e. able to gain access to *all* of the additional resources that are required in order to use it. Furthermore, the system compares the new technology’s likely ability to tolerate imprecise management, as expressed by its expected solution space, with the precision of the farming systems operated by the members of each social group. Only those social groups whose members farm with sufficient precision to make use of the technology without undue risk are selected, since only these people are in a position to make use of it.

The final two dimensions in which the new technology has been described refer to the range of environments within which the technology will work (as measured by the range of levels of rainfall that it can tolerate) and where using it would make sense (as measured by the logic range of the technology). The decision support system therefore identifies those districts whose average rainfall and agricultural logic fall within the range that is appropriate for the technology in question.

The endpoint of this matching process, then, is a calculation of the number of people who (i) belong to the selected social groups (whose members are likely to be interested in the benefits offered by the technology and in a position to use it), and (ii) live in districts where use of the technology would be both feasible and appropriate. The total number of such likely users of the technology is therefore calculated, using the district-level population data and other demographic information held within the decision support system. This number represents our estimate of the total impact of actually developing and implementing the technology in question.

Policy-relevant impact

While policy-makers are naturally interested in maximising the overall impact of their investments in new technology, they may be particularly interested in assisting particular sectors of society. In many cases, it is an explicit objective of policy to assist women, poor people, and other disadvantaged sectors. We use the term policy-relevant impact to denote the impact of a new technology upon those sectors of society that are of particular interest to policy-makers. The decision support system therefore provides estimates of such policy-relevant impact, in the form of numbers of people who belong to specified sectors of society and are likely to make use of the technology in question.

A more comprehensive picture of the probable impact of a proposed new technology is given by the ‘market segment reports’ that are also available from the system. These reports show the numbers and percentages of the members of each market segment who are likely to make use of a given new technology. A research manager aiming to assist particular sectors of society first needs to identify the market segments(s) to which the people in question belong, using the descriptions of each market segment that the system provides when defining the market segments. The market segment report may then be used to confirm that the technology in question is likely to be useful to a high proportion of the market segments that have been identified as being of interest. Since each market segment is composed of a number of social groups that are similar in terms of their interests in benefits and their capacities to gain access to resources, it is probable that most of the people within a market segment will respond in the same way to any given technology.[8] The descriptions of the market segment(s) likely to benefit from the new technology will thus show all of the social groups that can be expected to make use of the technology if it is developed and implemented.

An example from the Ghana forest-agriculture interface

As reported in our previous paper (Reece, Sumberg and Pommier 2002), an Expert Panel was convened comprising three social scientists with considerable long-tern experience in Ghana and other forest-agriculture interface areas of West Africa. Their opinions were elicited by means of the 'scoring' process outlined above, and were later used to delineate four market segments. The resulting segments, which are described in Table 3, were named 'Men getting by'; 'Women struggling to get by'; 'Men struggling to get established'; and 'Male winners'.

We shall assume, for the sake of illustration, that the stated objective of policy is to provide agriculture and natural resource management technology options to the poorest producers, with a particular focus on women. It is then clear that segments 2 ('women struggling to get by') and to a lesser extent 1 and 3 ('men getting by' and 'men struggling to get established') should be given special attention by researchers and research managers: while women are concentrated in segment 2, poor people are evenly divided between the three segments.

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[8] Assuming, of course, that they live in a district where a new technology would work and would make economic sense.

Next, in Table 4, we present three technologies that are representative of those that have received the attention of national and international research organisations working in West Africa over the last two decades.[9] The question is, with only limited resources to invest, which of these has the greatest potential for policy relevant impact and so should be developed?

Using the panel data and matching strategy described above, the results presented in Table 5 show that *none* of these technologies, if developed, are likely to be relevant to the segment that is of the greatest policy relevance. This outcome, while disappointing, is consistent with a great deal of research-based evidence that few if any new technologies are readily accessible to resource-poor groups in general and to resource-poor women in particular.[10] However, it is clear that the technology called ‘Cleaning of farmer saved seed’ is likely to be used by a reasonably large proportion of the members of the two other market segments that include poor people, so that there would appear to be a strong case for investing further resources in its development. Perhaps more importantly, the decision support system shows in a clear and unambiguous fashion that developing the technology called ‘Mucuna for weed control in maize’ is unlikely to have any impact whatsoever, and should therefore warn policy-makers against wasting any further resources on developing this technology.

Furthermore, the decision support system supplies a set of ‘Failure analysis reports’ that indicate the reasons why a proposed new technology fails to ‘match’ the technological needs of any given group of people. From these reports, we learn that the technology called ‘Mucuna for weed control in maize’ did not offer any benefits that were of interest to its prospective users: while it offered a long-term increase in land productivity and a long-term reduction in the need for purchased inputs, the demand was for benefits that would be experienced in the short term. While the

[9] These are actual technologies that are currently under development. They were described by participants in the Kumasi Workshop held in December 2001.

[10] For a recent review of this evidence, see Doss (2001).

benefits offered by the other two technologies under consideration were of interest to all prospective users, not all of them enjoy access to all of the additional resources that their use would require. In particular, 'Women struggling to get by' cannot gain access to the additional labour and technical information (extension services) that they would need in order to make use of 'Cleaning of farmer saved seed'.

Conclusions and next steps

This report has presented a methodology for assessing the likely uptake of proposed new technologies. The methodology was articulated using the concepts presented in our two earlier articles (Reece and Sumberg 2002; Reece, Sumberg and Pommier 2002) and thus represents a synthesis of this entire body of work. This methodology has been made available to research managers and other prospective users in the form of *Interface*, the computer-based Decision Support System.

The methodology is innovative in several respects. It relies upon descriptions of proposed new technologies, which in part take the form of comparisons with the closest equivalent technology that is currently in use. This is a novel way of describing the anticipated output of a research project, but the technology developers who took part in the Kumasi Workshop had no difficulty in using it to talk about their work. Such descriptions of proposed new technologies are then compared with descriptions of the technological requirements of distinct 'segments' of the population of prospective users. Again, technological requirements are in part expressed in comparative terms that refer to the technology currently in use. These descriptions are generated by combining a form of knowledge engineering with the approach known as market segmentation.

When the description of a proposed new technology 'matches' a description of what is required by a segment of the population of prospective users, the decision support system estimates the number of people from that segment who would be likely to use the technology if it were developed. We believe that these estimates should help research managers to choose between competing research projects and to allocate scarce resources to those projects that are likely to have the greatest policy-relevant impact. Preliminary trials of the decision support system, using actual technologies that are currently being developed for use in the Forest-Agriculture Interface in Ghana, yielded estimates that are entirely consistent with the development community's experience of the difficulty of providing suitable technologies for resource-poor farmers. However, some field validation of the market segments that the decision support system generates, and hence of its estimates of policy-relevant impact, is clearly necessary before it can be used to inform research management decisions.

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Table 1. Simplified view of decision levels for priority setting in national research organisations. (Reproduced from Byerlee 2000)

Decision level	**Decision type**	**Common decision maker in supply-led approaches**
National	By programme (commodity, factor) — sometimes by region across programmes	Supreme research body such as agricultural research council or board
Programme	By sub-programme (disciplinary or technology type) and by region within programmes	Research programme co-ordinator or institute director
Sub-programme	By project (technology type and characteristics)	Sub-programme leader or departmental head
Project	By technology characteristics	Lead scientist for project

Table 2. Schema for matching characteristics of a Proposed Technology with those of Potential Users (located within Geographical Areas and Farming Systems).

	Matching with characteristic of:		
Characteristic of Proposed Technology	**Geographical Area**	**Farming System**	**Potential Users'**
Agricultural Logic	Agricultural Logic		
Environmental Range (Indicator: Acceptable rainfall range)	Average rainfall		
Management Range (Indicator: Solution Space)		Precision	
Benefits associated with use			Interest in benefits
Additional resources required for use			Ability to access additional required resources

Table 3: Descriptions of the 'market segments' distinguished within the rural population of the Ghana FAI

Segment name	Number of individuals[1]	Segment description
1. 'Men getting by'	983 thousand	Virtually all members are men who are predominately of intermediate age (72%) and intermediate wealth (57%). However, this segment includes a small number of wealthy women, who account for 5% of its membership. It is relatively easy for the members of this segment to gain access to additional land, although like all groups their capacity to gain access to additional resources is in general low. They have a low level of interest in all the benefits considered.
2. 'Women struggling to get by'	1,940 thousand	Members are exclusively women, who are predominantly (83%) young or of intermediate age, and poor or of intermediate wealth. They have particular difficulty in gaining access to technical information and to purchased inputs, and in general have even less ability than other groups to gain access to additional resources. They have an unusually high level of interest in obtaining increases in the productivity of land (short-term) and labour. Like other groups, they also have a high level of interest in obtaining a short-term reduction in the need for purchased inputs. However, they have a low level of interest (lower than other groups) in a shorter cropping cycle and in better timing of key events in the cropping cycle.
3. 'Men struggling to get established'	924 thousand	Virtually all members are young men (92%) who are predominantly of intermediate wealth (56%), with a minority (36%) who are poor. However, this segment includes a small number of wealthy women, who account for 5% of its membership. Their

		capacity to gain access to additional resources is similar to the average for all groups. They are particularly interested in obtaining a short-term reduction in the need for purchased inputs, and also have high levels of interest in obtaining a shorter cropping cycle, better timing of key events in the cropping cycle, an increase in labour productivity and a short-term increase in land productivity.
4. 'Male winners'	95 thousand	Members are all wealthy men and predominantly young (46%) or of intermediate age (41%). Their capacity to gain access to additional resources is far greater than that of other groups, but they still have considerable difficulty in gaining access to additional purchased inputs, and even greater difficulty in obtaining technical information. They have less interest than other groups in increasing the productivity of land and labour (although they do still have high levels of interest in these benefits), and above-average levels of interest in a shorter cropping cycle and in better timing of key events in the cropping cycle.

[1] The estimated number of rural residents over 16 years of age in the Ghana forest-agriculture interface in this segment.

Table 4. Descriptions of proposed technologies.

Technology	Benefits to be gained	Additional resources required	Solution space	Acceptable rainfall	Agricultural logic
Cleaning of farmer saved seed	Long-term reduction in the need for purchased inputs; Improved product quality; Increase in labour productivity; Better market window; Short-term and long-term increases in land productivity	Labour; Technical information	Flexible	800 – 2,500	Extensification - Intermediate
Mucuna for weed control in maize	Long-term increase in land productivity; Long-term reduction in the need for purchased inputs	Technical information	Precise	500 – 1,500	Extensification - Intermediate
Dual purpose cowpea variety	Short-term increase in land productivity	Labour; Purchased inputs; Technical information	Flexible	700 – 1,300	Extensification - Intermediate

Table 5:

Segment name	Total number of individuals[1]	Number of individuals likely to use Technology 1: Cleaning of farmer saved seed	Number of individuals likely to use Technology 2: Mucuna for weed control in maize	Number of individuals likely to use Technology 3: Dual purpose cowpea variety
1. 'Men getting by'	983 thousand	633 thousand (64% of segment)	0	406 thousand (41% of segment)
2. 'Women struggling to get by'	1,940 thousand	0	0	0
3. 'Men struggling to get established'	924 thousand	578 thousand (63% of segment)	0	265 thousand (29% of segment)
4. 'Male winners'	95 thousand	61 thousand (65% of segment)	0	43 thousand (46% of segment)