p and Livestock Research in the Public lone to Enhance Information Sharing for Improved Productivity and Production?

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Background

Various nations find their niche strengths for development and in the case of Zimbabwe, agriculture is one of the pivotal economic drivers. For the latter reason, agriculture features strongly in the national Medium Term Plan (MTP) for the period 2011-2015. The primary outcome for the MTP is achieving self-sufficiency in food and nutrition with surpluses for export. However, the challenge is for policy to maintain a good balance when investing in the various nodes of the agricultural development chain. Such investment requires a highly coordinated approach with clearly laid out implementation plans that inculcate accountability at various levels of decision making and implementation of programmes and projects. For these reasons, in 2012, Ministry of Agriculture, Mechanization and Irrigation Development coordinated the review and compilation of an Agricultural Policy Framework for Zimbabwe ï to cover the period 2012-2032. The policy document took into account contributions of key entities with a stake in Zimbabweôs agricultural sector. Once publicly available the Policy document is expected to, in addition to other policy documents that may be developed in future, give strategic guidance to the agricultural sector.

This particular paper highlights some of the strategic issues that affect crop and livestock research; research information sharing, and related advisory and regulatory service delivery. The paper draws heavily on what is happening in the Department of Research and Specialist Services (DR&SS) as an example of a publicly funded research institution. It also proffers some suggestions on requisite improvement of agricultural research and extension coordination.

1. Funding issues

For both crops and livestock research, the level of funding is an important factor in achieving good results or otherwise. Economies that develop rapidly pay particular attention to technological needs that would propel them forward and they invest strategically in those selected areas. In tandem, they recognize the implicit nature of research as a precursor to development and economic growth of a nation.

Generally, two main types of research exist in agriculture. One type is **applied** research, which is designed to generate technology and information for immediate applicability in increasing productivity and production at the farm level. The other type of research is **basic** and **exploratory** - designed to come up with entirely new knowledge which could, in the long term, be applied to improve productivity and production. Both types of research are important. However, many developing nations, especially in Africa, tend to invest in the first type, i.e. applied research. The latter approach to research is understandable since the first aim is always to achieve food self-sufficiency. Developed economies of the west and the rapidly growing economies such as those of China, Japan and Brazil, also invest heavily in exploratory research to find new sources of products, information and technologies.

The African continent is rich in resources. Therefore, it is also very possible for African countries to devote more resources to strategic applied and exploratory research. The investment will be possible when certain fundamentals such as trading in resources to the advantage of the source countries are achieved. A good example is that of investing proceeds of the finite mineral resources in sustainable agricultural development for now and for future generations.

In Zimbabwe, the current constrained funding has major impacts on facets that support research, especially in the public sector. Examples of strategic impacts of research, as well as challenges of constrained funding are highlighted below.

The DR&SS is a public institution established in its current form in 1948. It conducts research in both crops and livestock, in addition to providing specialist and regulatory services to the agricultural industry.

Among its long term major achievements and impacts on national development, the department has contributed the following:

***Crops*: The **first locally** developed crop varieties to be produced by farmers in Zimbabwe. Major crops of focus were cereals such as maize, wheat and barley; cotton; soyabean; sorghum and potato in the initial years of breeding. From 1980 onwards, varieties of traditional grain legumes (cowpea ï *Nyembal Indumba*, bambara groundnut ï *Nyimol indhlubu*), beans and traditional cereals (pearl millet ï *Mhungal Inyauthi* and finger millet ï *Zviyol Rukwezal Uphoko*) were also released for use by farmers. Coupled with the correct fertilizer use, improved agronomic techniques and crop protection, the varieties increased productivity per hectare by between 25 and 155% (Tawonezvi and Hikwa, 2006) in initial years, with further increases of up to 168% and 215% in crops such as maize and wheat, respectively, in later years. The yield leaps in wheat were particulary complemented by research that came up with the most suitable irrigation technology for producing the crop under Zimbabwean conditions.

***Livestock*: Development of dry-season feeding strategies reduced the slaughter age of beef steers from between 3.5 and 4.5 years to between 2.5 and 3.0 years. The spinoff was increased off-take of up to 150% per herd (Tawonezvi and Hikwa, 2006). Furthermore, long term research-based breed evaluation studies (1957-1999) clearly confirmed the performance superiority of indigenous cattle over exotics and brought out the undisputed potential for selective improvement within indigenous breeds of *Mashona*, *Tuli* and *Ngunil Nkone* (Tawonezvi, Khombe and Ward, 1988; Moyo, 1990; Tawonezvi and Hikwa, 2006).

: Research on the role, nutritive value and use of feed further proved the inter-dependence of crop and livestock production, in all major agricultural production systems on Zimbabwean farms. On the research side, the strong interaction between crops and livestock research in coming up with integrated production information cannot be over emphasized. For example, pastures and forage agronomy and evaluation of nutritive value of crop products in feed formulations and testing on livestock, involves team work consisting of both crops and livestock specialists. Therefore, it is not by coincidence that the crops and livestock research for supporting integrated crop/livestock production on farms, sits under one roof at DR&SS.

***Specialist and Regulatory Services*:** The Department has continued to protect Zimbabweôs agriculture by providing a dependable and competitive **regulatory** service that promotes cooperation among agro-industries, farmers and Government - thus assuring the nation of quality agricultural inputs, compliance to sustainable agricultural production and growth.

3. Some of the impacts of constrained funding include:

3.1 Disruption to Research Projects within Defined Programmes:

The major challenge even for applied research has been the ability to sustain a reasonable level of funding for programmes, especially to support research projects to their logical conclusion. The ñtroughsò in funding availability or the lack of funds mean that some long term projects, such as those in livestock breeding or crop variety development are interrupted and left inconclusive. The net sum is that resources would have been expended on initiated projects, but with no results, leading to wastage of same.

3.2 Extent of Research Location Sampling:

The strength of applied agricultural research lies in the ability to sample appropriate locations for the specific technology. For instance, if a programme is breeding for drought tolerance in a particular crop, the staff in the programme must be able to use locations where drought is most prominent in order to select the best performing varieties. This strategy requires mobility to such locations to carry out verification of research findings and also carry out adaptive research.

farms together with extension agents and farmers, opportunity to assess if the findings are acceptable to them. The participatory interaction is also used to gauge the required level of training for field extension trainers for increased technology adoption.

In the face of lack of funding, vehicular transport and travel resources are inadequate or unavailable. The latter precludes research staff from reaching key locations off station and from gaining solid feedback on performance of research results. Currently, publicly funded research institutions are the most affected by the dearth in funding. The situation pushes such institutions to be more and more dependent on donor funding, which in itself can never replace the need for Government funding. Moreover, public sector research programmes and projects must be driven by national needs and donor funding should only play a complementary role and not *vice versa*.

3.3 Condition of Physical Infrastructure:

Over time any infrastructure undergoes natural ware, tear and ageing. Old buildings that are not well maintained at research stations do not protect assets against the effects of weather damage, pests such as rodents and theft. Most buildings, including laboratories, have not had resources allocated for repairs and maintenance over many decades. Working in poorly maintained buildings can easily be a source of de-motivation and affect staff performance.

Rusty and irreparable fences have cost the nation of assets such as livestock that stray out of research farms and get stolen and conserved live crop germplasm that is constantly destroyed by wild animals such as pigs.

3.4 Condition of Field and Laboratory Equipment:

Replacement of **moveable** laboratory equipment has tended to depend a lot on donations, with some of the laboratories of strategic importance to the nation having benefitted in recent times. Examples include the Seed Testing laboratory and the breeding programmes, which benefitted from COMESA; the microbiology laboratory and the legume inoculants factory which benefitted from being equipped by International Centre for Tropical Agriculture (CIAT); the molecular

programmes, which was set up with equipment omic Energy Agency (IAEA) of the United Nations.

Some of the **fixed** laboratory equipment dates back 30-40 years and is no longer efficient both in **speed** of performance and **quantity** of output per given time, despite regular repair. Some of it is no longer repairable as it breaks down due to lack of spare parts.

Research farms use implements and field equipment such as tractors, ploughs, planters, herbiciders (boom sprayers) and other equipment that is appropriate for use in crop and forage production and for maintenance of fireguards. In addition, livestock research farms require tractor-drawn grass cutters, hay rakes and bailers for processing hay, as well as forage choppers for preparing silage for livestock. New tractors acquired in more recent times were those that were availed by Government to all institutes in November 2004. A few research institutes have also been able to procure additional tractors using revolving funds (revenue generated in the course of work). Otherwise replacement of most implements and equipment has been far and apart over longer durations than desirable. Most of them are now obsolete or are in a state of obsolescence.

3.5 What can be done in the face of constrained funding?

Capital investment may not be achieved all at once considering the physical infrastructure, field and laboratory equipment that require repairs and servicing. Therefore, it is critical to have an asset replacement/ repair strategy that allows for defined funding to be released each year for procurement and/or repairs. For this purpose, the Public Sector Investment Programme bids drawn up by Departments annually would need to receive greater attention by Treasury and be used as the basis for selecting the **number** and **size of projects** for funding each year.

In the case of DR&SS, Treasury response was very positive in the last three budget years (2011, 2012 and 2013). The response was stimulated by an organized tour to research stations for desk officers at Treasury ï where they were able to appreciate the actual status beyond what is written on paper. The Department was able to get some funding for procuring fences and to repair some

re. The permanent Secretary in the Ministry of d Irrigation Development was also able to buttress fund allocation to have rehabilitation of additional infrastructure, e.g. the renovation of the old Milking Parlour at Henderson Research. In addition, funds have been allocated by Treasury for modification and modernization of the two story building to host the Food and Agricultural Products Testing Laboratory. The state of the art equipment to the latter laboratory will be courtesy of the Government of India. This demonstrates that even against constrained budgetary inflows at Treasury, it is still possible to strategically channel some funds into infrastructure development and maintenance each budget year. It is important to note that strategic investment by Government in turn has the effect of attracting complimentary investment by strategic partners.

The same ñcommon purposeò approach alluded to above, needs to be adopted when funding research projects. This can only happen when the monitoring and evaluation system is translated from ñdocumentedò into ñpracticalò form.

4. The Human Capital

The overall staffing level in DR&SS is currently at 85%, i.e. 2043 out of an establishment of 2401 (Annexure 1). Of the staff in post, 19.9% (407) are agriculturally trained, with 8% (164) at degree level and 11.9% (243) at diploma level. This is a comparatively much more improved situation than what prevailed during the hyperinflationary period between 2003 and 2008.

Despite the reasonable level of staffing, the major challenge is that of relative experience. An investment in human capital development is absolutely necessary. There is need to recognize efforts made in the area of staff development through short term courses that mainly came through the Public Service Commission from countries such as China, India, Egypt to name but a few. However, the area of formal academic training to further skill staff with additional technical knowledge, has lagged behind in recent years. Granted, it is expensive to support staff development at MSc and PhD levels, but it is necessary. Windows of opportunity to train at these levels have mostly been through collaborative projects and direct offers of scholarships.

untry have had negative impacts in the sense that o support academic training are not doing so at the moment. In the 1980s and 1990s, DR&SS benefitted immensely from special arrangement on training at MSc and PhD levels. Examples of such programmes included the support from British Council to train at least ten (10) researchers with BSc qualifications at MSc level each year. Another programme with the Rockefeller Foundation was designed to support at least three (3) Researchers per year at PhD level, initially over a ten-year period. The two programmes fed into each other, with the latter meant to further upgrade the MSc output.

Similar programmes could in future be re-considered. When such opportunities become available, a deliberate policy of training staff to cover those specialized disciplines where experience has been lost would be necessary. These include, but are not necessarily confined to livestock breeders, virologists, nematologists, crop physiologists, soil physicists and pedologists, etc. It, however, is necessary to couple staff development with a sound retention strategy in order to keep experience that will contribute meaningfully to national development. One school of thought propounds a parallel promotion system, whereby researchers are promoted up to the equivalence of principal directors within the research pathway, rather than them crossing over to the management pathway after chief research officer grade or opting out of the public sector research system in order to achieve further professional growth.

5. The Research and Extension Interface System

5.1 Interdependence of agricultural research and extension:

Agricultural technology development derived from the research function and that of technology transfer to users through the extension function are highly inter-dependent. Neither research nor extension institutions can on their own fulfil their responsibility without the other. By the same token, in the technology value chain, funding one at the expense of the other only serves to create a disjointed ineffective strategy that may not yield the desired outcome.

When a workshop was called in May 1990 to assess the research and extension interface set up between DR&SS and AGRITEX in the 1980s, there was an

committee for on-farm Research and Extension
ndation, justifying further development of structures
that would support it effectively (Pazvakavambwa, 1990). The inter-face had fulfilled the objectives for which it was set up (Shumba, 1990). However, the need for the inter-face to be sustainably funded was brought to the fore (Fenner, 1990).

The current effort by the Ministry of Agriculture, Mechanization and Irrigation Development to clearly define an implementable research-extension interface is a step in the right direction. The interface should serve as an information sharing vehicle up to the client and inversely input into research programmes. For its sustainability, this kind of platform would require a budget to set it up and thereafter, dedicated operational funding. Some would argue that research and extension already have funding structures and therefore could draw on such funds. However, the kind of interface alluded to here is a coordinating platform that should bridge the gap between technology generation and use. Therefore, it does deserve not only a budget, but also a well defined mechanism for coordination.

At the beginning of the 2000s, one school of thought believed strongly that bringing together DR&SS and AGRITEX into one department would quickly solve the inter-face chasm. However, when the two departments were amalgamated in 2001, the resource allocation did not match the size and the ñfunction contentò of the new department. The result was a drift of research and extension from each other due to intense internal squabbles over the limited resources? The good working rapport that had been established prior to this merger of the two departments and especially enhanced by the COFRE era was badly damaged during this period.

***5.2 Aspects to consider in a functional research-extension interface*:**

In making the ensuing suggestions, the assumption was that the interface platform would have laid down terms of reference to guide its function. The suggestions proffered are not conclusive, but include:

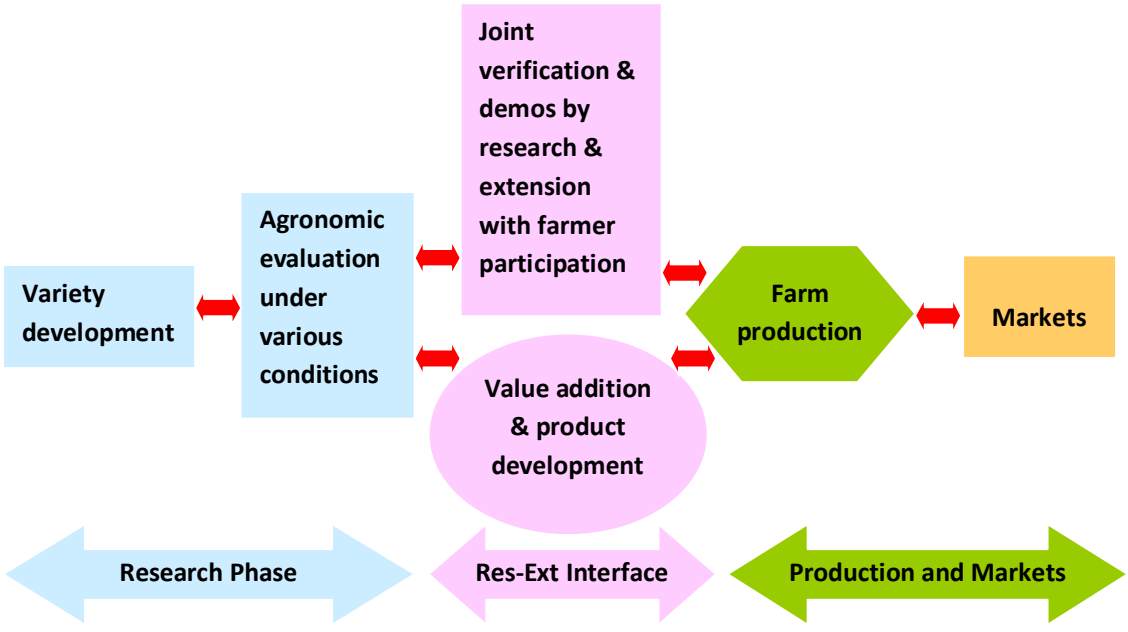
strengthen information sharing through regular seminar presentations to cover specific topics, including information from on-going research projects. These could target subject matter specialists in Branches, at Province and at Districts. Equally, seminars by extension would provide feedback that allows research programmes to elicit researchable areas.

5.2.2 Joint Research and Extension Projects:

Projects at the stage of technology performance verification on farm could be jointly implemented. This would expose field extension and farmers to new or modified technology, while at the same time benefiting researchers with immediate feedback for input into research programmes.

For example, an area that could benefit from a joint strategic effort is that of value addition to agricultural products. This ties in well with both animal and crops products outputs and could be built into a value chain as illustrated in figure 1.

Fig. 1: Research-extension interface for improved information dissemination

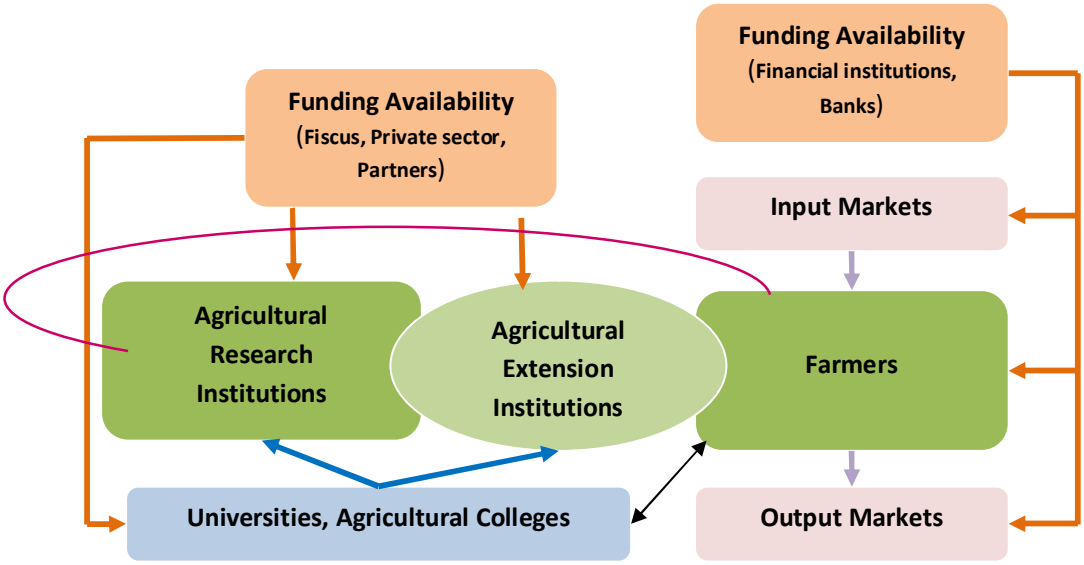


5.2.3 *Multi-partnership Projects*:

Multi-partnership projects would bring together research (both national and from international institutions), extension and agricultural training institutions

partnerships would also allow training institutions to g needs of clients in the design of their teaching curricula. Partnerships with universities have moved a step further from just student attachments to research institutions to include memoranda of agreements (MOAs) that promote sharing of research facilities. Such examples include the DR&SS-CUT, DR&SS-MSU and DR&SS-ZOU MOAs that are currently under development for future partnerships. The underlying factor is that projects would still involve the research and extension functions as illustrated in figure 2.

Fig. 2: Training-Research-Extension-Farmer Linkage and related Funding &



5.2.4 *Training of Extension Trainers in Specific Specialist Areas*:

Field extension provides the first line of advisory and therefore, training extension staff in specialised areas is very critical for effective extension delivery to farmers. As an example they could be empowered with knowledge of even existing agricultural regulatory frameworks governed by Acts of Parliament in order to enhance their effectiveness in advising farmers on the reasons and need for compliance; be trained in planning, designing and data collection for statistical analysis in verification and demonstration projects.

Various research institutions do carry out such training, but this tends to be *ad hoc* and according to availability of funds at any given time. There is, however, a need to have well designed programmes back to back with a follow up monitoring and

onitoring and evaluation models do exist. One such **Four-Level Model** of evaluation, which some programmes are currently using (Annexure 2). This is a four-level evaluation system developed more than 40 years ago, but has stood the test of time and continues to be utilized in many training programmes around the globe today.

5.2.5 *Documentation and Information Centre*:

A documentation and information centre is more than just a library. This is a dynamic set up that documents and publishes, stores and retrieves information on demand by clients. A library and an archival repository would also be included with such an information centre. It should be manned by expertise which is able to quickly respond to clientsôneeds and also competently refer them to additional expert sources of information. The system could then be developed further to link with information points at Provincial, District and Ward levels. This is one important link which is currently missing in the Ministry and in particular in a research institution such as DR&SS. Current negotiations with the Public Service Commission for the re-establishment of such an information unit within the DR&SS are underway.

6. Change Management for a Coordinated Approach

Coordination is time consuming and expensive, but necessary for successful partnerships that deliver. It requires a change management approach that eliminates entrenched ñcompetitionò while promoting ñmulti-disciplinaryò team work. The starting point is within the Ministry of Agriculture, Mechanization and Irrigation Development itself, but it would need a trainer who is also a good negotiator.

The change management approach could be put into practice in selected key multi-disciplinary **strategic** projects that are supported by well integrated funding. This could be back to back with leadership training in aspects such as team building, conflict resolution and project accountability and ownership.

A certain level of dedicated funding investment and human resource commitment is necessary for **real** rather than **lip service** coordination.

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Annexure 1: Summary of DR&SS Staff by Gender and Education as at January 2013

Designation	Total No. of Approved Posts	Total No. of staff in post	Breakdown of Staff in Post															
			PhD		Masters		BSc/BA		Diploma		Certificate		'O' & 'A' Level		Below O'Level		Total	
			Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	**Male**	**Female**
Principal Directorôs Office	**17**	**12**	0	0	0	1	1	1	0	1	0	0	2	4	1	1	**4**	**8**
Division of Crops Research	**1062**	**918**	0	1	7	6	35	15	37	27	50	43	93	48	381	175	**603**	**315**
Division of Livestock Research	**626**	**547**	1	0	3	1	17	13	22	12	22	14	92	80	220	50	**377**	**170**
Research Services Division	**676**	**563**	4	0	3	5	36	18	86	63	56	33	47	41	84	87	**316**	**247**
DR&SS Reserve Pool	**20**	**3**	0	0	2	0	0	0	0	0	0	0	0	0	0	1	**2**	**1**
Total	**2401**	**2043**	**5**	**1**	**15**	**13**	**89**	**47**	**145**	**103**	**128**	**90**	**234**	**173**	**686**	**314**	**1302**	**741**

Annexure 2: Kirkpatrick's Four-Level Model of Evaluation

The Model includes the following components:

Level I: Reaction
First level evaluates how well participants liked the training session. If you're interested in running the best training program possible, you want participants to be motivated for and engaged with training. This exercise gives trainees the opportunity to give feedback to the trainer on the pros and cons of the session, which is valuable information that shows trainers specific areas to improve.

Tips when obtaining feedback on traineesô reactions:

a. Observe trainees during the session for your own perception of their reception.
b. Get trainee feedback in writing immediately following the session.
c. Use measurable and meaningful terms.
d. Use uniform feedback forms so results can be quantified and tabulated for the whole group.

Reaction Surveys:
Ideally, trainers will include reaction surveys as the final section of training sessions and will insist on 100 percent participation. Make surveys easy to fill out by following these guidelines:

- Use a numbered rating system, i.e. 1 to 5, with 1 being the low end of satisfaction and 5 being the high end.
- Use close-ended questions, such as those requiring the numbered assessment mentioned above to assess traineesô impressions of the overall success of the session.
- Use open-ended yet directed questions that require more than a Yes or No answer along with space for trainees to write their comments in order to get detailed feedback on specific things that worked or didn't work.
- Include space for undirected questions or comments on topics that trainees want to address.

Level II: Learning
This level measures how much of the desired principles, techniques, and skills trainees learned in the training session. In order to determine what trainees learn during a session, you need to know what they knew before training. Suggestions for measuring learning include:

- Use pre- and post-knowledge and/or skills testing.
- Use objective measurements to assess what trainees now know or can do that they didn't know or couldn't do before training.
- Use a control group of persons who did not attend the training session to compare their performance to persons who received training.

Level III: Behaviour

The third level measures employee behavior changes based on training. Your goal is to see how well trainees incorporate learned principles, skills, and knowledge into their jobs on a permanent basisð or at least until they learn a new and better way to perform. The methods for evaluating behavior include:

- Solicit the help of trainers, supervisors, and others who work closely with trainees to observe these employees before and after training, and to give their measurable, objective feedback on performance.
- Continue observations for 3 to 4 months or more after the training session, so you can get an accurate assessment of whether trainees have made permanent performance improvements based on training.

Level IV: Results

Kirkpatrickôs first three levels focus on trainees and the effect of training on their performance. The last level in Kirkpatrickôs evaluation model focuses on the results of training on the company in terms of:

- Reduction of costs
- Reduction of turnover and absenteeism
- Reduction of grievances
- Increase in quality
- Increase in quantity or production
- Improved morale

Suggestions for measuring the results of training on the overall performance include:

- Measure statistics in each of the categories listed above (or whichever categories you included in your goal-setting) before and after training.
- Use a control group, if possible, for comparison.
- Measure more than once over several months to allow time for changes from training to affect the specialist areas trained.

Evaluation by Return on Investment (ROI) Analysis (or the Fifth Level of Evaluation)

Some training professionals consider ROI analysis to be one method for determining the results of Kirkpatrickôs fourth level of evaluation. Others consider ROI its own level and make it the 5th level of evaluation. In any case, this method is an effective way to measure the success of your training program.

ROI analysis gives the trainer data about the financial impact training programs have on the organization. It differs from Level IV evaluation in the sense that Level IV takes into consideration nonfinancial data such as participantsôsatisfaction. ROI analysis deals strictly with the financial impact of training. It answers the question ñFor every dollar invested in training, how many dollars the employer gets back?ò

Here are three great reasons to use ROI analysis:

1. It's a concrete way to validate your training program as a business tool.
2. It can be used to justify the cost of your training program to upper management.
3. It can be a useful tool for choosing future training methods.

Many business executives view training as a business expense and, therefore, measure its worth in terms of profits made or savings earned from this expense. You need to make sure training is seen as beneficial to your company.

ROI Formula: ROI (%) = Monetary Benefits - Training Costs x 100

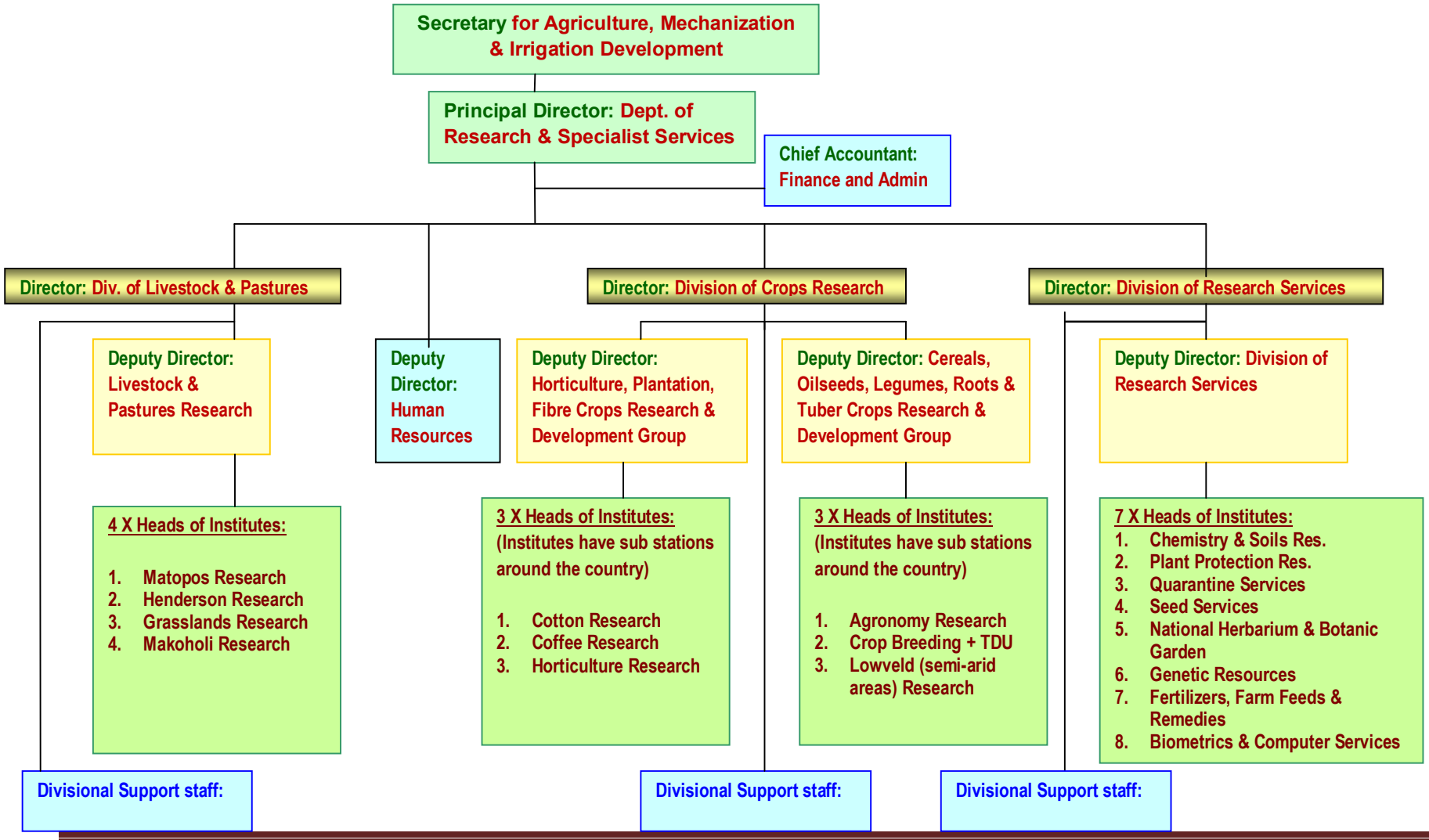
Costs: To get the figures for this formula, keep track of training costs, including:

- Design and development
- Promotion
- Administration
- Delivery (staff or technology)
- Materials
- Facilities
- Employee wages
- Evaluation

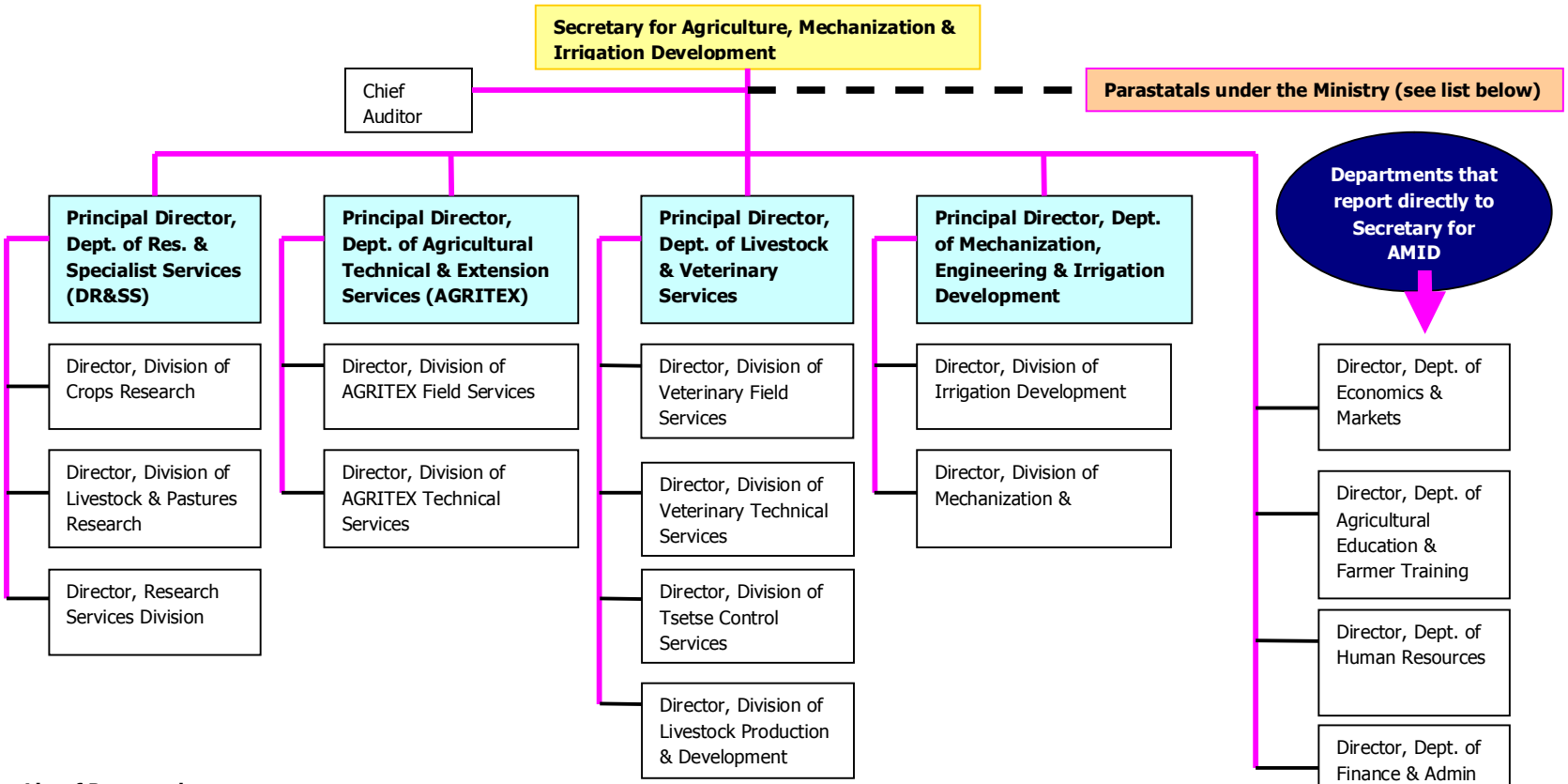
After training, keep track of monetary benefits, including:

- Labor savings
- Productivity increases
- Income generation
- New leads
- New products
- Lower turnover costs

Annexure 3: Structure of the Department of Research & Specialist Services (DR&SS): Top Part



Annexure 4: Ministry of Agriculture, Mechanization & Irrigation Development Senior Management



List of Parastatals:

1. Agricultural & Rural Development Authority (ARDA)
2. Agricultural Marketing Authority (AMA)
3. Agricultural Development Bank (AGRIBANK)
4. Agricultural Research Council (ARC)
5. Cold Storage Commission (CSC)
6. Pig Industry Board (PIB)
7. Tobacco Industry & Marketing Board (TIMB)
8. Tobacco Research Board (TRB)
9. Grain Marketing Board (GMB)