



REPUBLIC OF RWANDA

And the World Bank

Needs Assessment and Action Plan for Improving Agricultural Research and Technology Transfer

Final Report

Clesensio Tizikara,
David Wilcock,
Pierre Celestin Habyarimana

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List of abbreviations

Abbreviation	Full name
ACDI-VOCA	Two US-based cooperative development NGOs, “Agricultural Cooperative Development International” and “Volunteers in Overseas Cooperative Assistance”, merged in 1997, and working in Rwanda with monetized food aid USAID Project “Assistance to Agribusiness Development in Rwanda”
ADAR	
AfDB	African Development Bank
AFSR	BTC Project “Support to Seed Value Chains in Rwanda”
ARTT	Agricultural Research and Technology Transfer
BTC	Belgian Technical Cooperation
EDPRS	Economic Development and Poverty Reduction Strategy
EU	European Union
FACAGRI	Faculty of Agriculture
FDI	Foreign Direct Investment
GoR	Government of Rwanda
GTZ	German Technical Cooperation
HIDA	Human Resources and Institutional Development Agency
IFAD	International Fund for Agriculture Development
ISAR	Institute of Agronomic Sciences of Rwanda
IRST	Institute of Scientific and Technological Research
KIST	Kigali Institute of Science, Technology and Management
MIFOTRA	Ministry of Public Service
MINAGRI	Ministry of Agriculture and Livestock
MINALOC	Ministry of Local Government
MINICOFIN	Ministry of Finance & Economic Planning
MINICOM	Ministry of Commerce, Industry, Investment Promotion, Tourism & Cooperatives
MINEDUC	Ministry of Education
MININFRA	Ministry of Infrastructures
MINISTR	Ministry of Science, Technology & Research
MINITERE	Ministry of Land and Natural Resources
NAIS	National Agricultural Innovation System
NARB	National Agricultural Research Board
NGO	Non Governmental Organization
NUFFIC	Netherlands Organization for International Cooperation in Higher Education
NUR/UNR	National University of Rwanda
OECD	Organisation for Economic Cooperation and Development
OTF	On The Frontier
PEARL	Promoting Enterprises and Agriculture through Research and Linkages
PRSP	Poverty Reduction Strategy Paper
PSTA	Program for Agricultural Sector Transformation
RADA	Rwanda Agriculture Development Agency
RARDA	Rwanda Animal Resources Development Authority
RIEPA	Rwanda Investment and Export Development Agency
RPSF	Rwanda Private Sector Federation
SPREAD	Sustainable Partnership to Enhance Rural Enterprise and Agriculture Development
TBIF	Technology & Business Incubation Facility
WB	World Bank

1. INTRODUCTION

1.1 Background

1. The Government of Rwanda (GoR), through the Ministry in the President's Office in charge of Science, Technology and Scientific Research (MINSTR), and with funding support from the World Bank, is designing a multi-faceted science, technology and innovation (STI) capacity building program in collaboration with various GoR line ministries and agencies. The process is in two stages: the first involves the execution of a series of single or multiple sector STI capacity assessments, and the preparation of selective action plans to be included in the Government's Economic Development and Poverty Reduction Strategy (EDPRS) for the period 2008 - 2012. The second stage will be the financing and implementing of the agreed policies and programs as prepared under the first stage, with funding primarily provided by bilateral donors and the World Bank.

2. Needs assessments and action plans are to be prepared in following seven priority areas: 1) agricultural research and extension, 2) food processing and preservation, 3) bio-fuels development, 4) geosciences and geothermal energy, 5) appropriate technology for poverty reduction, 6) technical and vocational education and training, and 7) drinking water supply.

3. The studies on appropriate technology, food processing, and water supply have been completed. The World Bank engaged a team of three consultants (two international, Clesensio Tizikara and David Wilcock; and one national, Pierre Celestin Habyarimana) to undertake this study on agricultural research and extension, which was done over the period of 2 May to 6 June, 2007, in collaboration with the Ministry of Agriculture and Animal Resources (MINAGRI and its component implementation agencies, RADA, RARDA, and RHODA) and its research arm, the *Institute des Sciences Agronomiques du Rwanda* (ISAR). The observations and analyses of the team, and the proposed strategy and action plans were presented to a stakeholder workshop on and comments and corrections from that meeting have been incorporated in this report.

1.2 Promoting the Flow of New Technologies in Innovation Systems

4. **Agricultural research** can range from simple experimentation in a training setting, to the systematic and intensive scientific investigation of complex issues and phenomena. Research generates knowledge: technologies, practices, strategies, and information. The objective of an "innovation system" is that this new knowledge will become useful to the "end users", farmers and others adding value elsewhere in the commodity value chains (e.g., fully washed coffee for export, "mosaic-resistant" cassava varieties for domestic consumption and transformation). To reach these end users, the improved technology (improved seeds, a better way of maintaining soil fertility, etc.) may often pass through several steps or institutional levels. At times in this flow of new technologies, it may not be clear to all participants exactly where the researcher's role ends, and the outreach or "extension" worker's begins. To avoid fruitless territorial or definitional debates, we prefer to focus on the **process of transfer of technology** between those who generate, or adopt it to Rwandan conditions, and those who make use of it in production, post-production processing, and marketing of agricultural products to final consumers.

5. The flow of results from research to the farmer has sometimes been seen as a "linkage problem" with extension. In the classic model of agricultural research, the job of the researcher ended with writing a good publication. With increasing demand for demonstrating that research has cost-effective impact, several "communication models"

have been elaborated. In the traditional “command-structure systems”, communication follows research. It is a one-way street from the researcher, often through an intermediary such as an extension agent, to the user (e.g. farmers). Researchers communicate through briefing notes, contributing to farmer field schools, or setting up and running technology demonstrations. Other methodologies used, especially in more developed countries, include the organization of research station field or “open” days, exhibitions, media events, workshops and seminars. Other techniques are used by downstream partners in both the public and private sectors: specialized training and technology delivery services (e.g., seed production and distribution, quarantine services, quality control services, germplasm conservation, land-use mapping, soil testing, etc).

6. How well do these systems work? In most OECD countries, where these systems originated, they generally work very well indeed. Politically powerful farmer’s groups (organized both geographically and by value chain) are able to insure that these systems work for them or they demand and get change. The majority of research and transfer functions have moved into the private sector.

7. In many African countries (except those where farm interests are also politically powerful, such as Kenya, pre-crisis Zimbabwe and Ivory Coast, etc.) many of the key research and transfer components are missing or poorly coordinated, and system performance suffers. Many research organizations find that the traditional “communication following research approach” has low adoption rates from users; research is not making use of the knowledge and resources of the users. Feed back and control loops are missing. This unbalanced and sequential development of research, extension, and farm-level adoption is a major cause of missing agricultural productivity increases.

8. A Paradigm Shift in Rwanda and some other African Countries: The new approach to agricultural research and technology transfer is to significantly increase the number of participants and their level of participation, until a more fully integrated national agricultural innovation system (NAIS) emerges. The “paradigm shift” comes with the recognition that successful innovations do not follow a linear path, but instead emerge from the interaction of the various actors operating in the rural environment in a partnership mode. The principle in the NAIS is that public and private research and extension agencies become partners to farmers and other stakeholders in identifying, testing and evaluating technological and institutional innovations. Users participate in research; knowledge flows both ways. Researchers are tasked to communicate with users early in the research design. The “innovation system” approach puts the client (farmers and other value chain workers) at the center of process of technology generation and transfer. Knowledge institutions (research, extension and education) collaborate based on commodity value chains. These chains are effectively linked to markets, and productivity increases are coupled with sustainable natural resource management.

9. Experience with publicly funded agricultural research and extension have led to this paradigm shift, some of whose characteristics are given in Table 1. The guiding principles and good practices emerging from this paradigm shift form the basis for the strategy proposed in this study.

10. In Rwanda this paradigm shift has been accelerated by history-driven occurrences in the two major parts of the system, research and technology transfer. The tragic events of the war/genocide period of 1993-4 destroyed much of the human and physical plant capacity of both research and extension. Research was reestablished in 1994-95, but has been limited of necessity to only conducting adaptive research for the most part. As it rebuilds, ISAR has had to demonstrate that its research outputs are contributing to the solution of real farmer problems.

Table 1: The Paradigm Shift: Changes in Principles and Practices

From the Command System :	To the Innovation system:
Support to Research Institutes	Support to Programs
Support to Messengers	Support to Advice
Farmers as Receivers of Messages	Farmers as Critical Thinkers
Donor Projects	Government Programs
Fragmented donor interventions	International Cooperation

11. The former chain-of-command extension structure was also reestablished in 94-95, but largely served as a means of distributing emergency relief in rural areas. In 1998 it was abolished and a large number of former extension workers in agriculture, livestock, and forestry were all let go. MINAGRI no longer had any direct means of reaching farmers. In its place, from 1998 to today, there has been an intensive period of experimentation in NGO, farmer union, and project-based transfer of technology. Common threads running through the best of these new approaches have been a much greater degree of user participation and feedback, and some timid initial efforts at enhancing farmer control of the technology generation and transfer process.

1.3 Study Objectives and Methods Used

12. The ToR of this study (see Volume 2, Annex 10) specifically call for an assessment of the current situation in agricultural research and technology transfer in Rwanda (with a substantial focus on ISAR and its downstream technology transfer partners), developing guiding principles for a national strategy to address revealed weaknesses, and an "Action Plan" featuring practical proposals to meet specific capacity constraints in the current system. Special emphases will be given to a research and technology transfer system that can both help mitigate food insecurity for the country's majority population (very small scale farmers) while, at the same time, promoting commercially viable export agriculture, across both "traditional export cash crops" and newer opportunities in high-value horticulture, as well as improving the performance of animal and animal product industries, post-harvest and storage research, and other related topics. The goal of the resulting study action plans is to selectively support the above goals through EDPRS interventions in agricultural research and technology transfer, in a sustainable, value chain context.

13. The study will thus focus on *developing a clear strategy and action plan for developing and strengthening a client-oriented, market-driven national agricultural research and outreach system for Rwanda*. The operational aim of the strategy is to build strong and active linkages among all stakeholders: public research institutions (ISAR and others), emerging commercial private sector companies, exporters, farmers, and education institutions (UNR, ISAE, KIST and others) in order to:

- a) Improve the quality and relevance of agriculture research in Rwanda, and
- b) Improve the transfer of new as well as existing techniques and knowledge to end users.

14. The team notes that in some areas there are overlaps between this study and the other STI studies, especially the ones covering food processing and preservation, appropriate technology, and technical and vocational education and training. The mission based its assessment of the current system on secondary data and information provided by stakeholders on representing both the supply and demand sides for agricultural research

and outreach services. The mission talked to central Government agencies, project staff, local authorities, research institutions, institutions of higher learning, NGOs, farmers' organisations, private sector organisations and companies.

15. The specific recommendations for Rwanda have emerged from the use of a Structure-Conduct-Performance analytical approach which has allowed us to identify a process framework (Figure 1) for use in making recommendations for the improvement of agricultural research and technology transfer (ARTT) in Rwanda. The framework in Figure 1 is based on:

- i) Identifying the main areas of needed priority technology generation and transfer in Rwandan agriculture
- ii) Evaluating the performance of the current system in terms of meeting these needs and why it is falling short,
- iii) Enumerating priority constraints in terms of missing institutional components and human capacity, poor inter-agency coordination, and functional factors, such as overly restrictive GoR financial management rules that stifle problem-solving initiative.

1.4 Report Structure

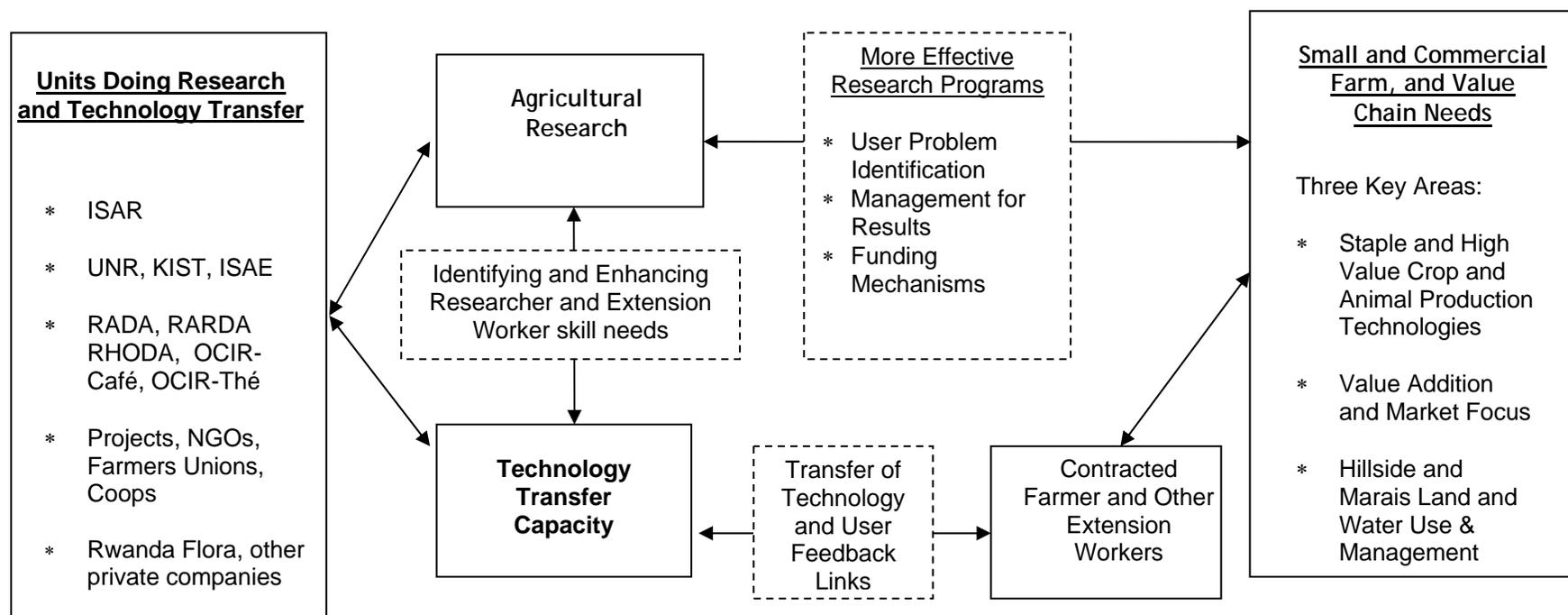
16. This report is in two volumes: the main report (Volume 1), and a set of more detailed supporting annexes (Volume 2). Following this introduction, **Chapter 2** of the main report contains the team's **assessment of the current situation in agricultural research and extension in Rwanda**, within the context of a desired future system of agricultural innovation.

17. Chapter 3 contains the resulting, **problem-solving Action Plan**. It is made up of an analysis of system needs and proposed corrective actions to address the problem/issue list that emerged from the system assessment in Chapter 2. The proposed activities in the Action Plan are those that we feel would be most useful in inducing better performance from the agriculture research and technology transfer (ARTT) system over a medium term (4-5 years), while longer-term capacity building (advanced degree training, etc.) is being undertaken to meet obvious personnel gaps. Chapter 4 is a tabular summary of the proposed action plan.

18. Volume 2 contains study background information and more detailed assessment and guidance materials in the following ten annexes:

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|-----------|----------------------------------------------------------------------|
| Annex 1: | GoR Policies for General and Agriculture Sector Development |
| Annex 2: | Inventory and Analysis of Stakeholders |
| Annex 3: | Agriculture Extension in Rwanda: Past Systems and Future Directions |
| Annex 4: | Agricultural Education and Training |
| Annex 5: | Funding Mechanisms for Agricultural Research and Technology Transfer |
| Annex 6: | Agribusiness Needs for Research and Technology Transfer |
| Annex 7: | Definitions of Terms |
| Annex 8: | Bibliography of Documents Consulted |
| Annex 9: | List of Persons Met |
| Annex 10: | Study Terms of Reference |

Figure 1: An STI System for Agricultural Research and Technology Transfer (ARTT) in Rwanda



2. ASSESSMENT OF THE CURRENT ARTT SYSTEM

2.1 Needs for Agricultural Research and Technology Transfer

19. Over the last 25 years there have been many agricultural sector needs assessments in Rwanda (see documents reviewed in Vol. 2 Annex 8), and several in the last five years. Sector development has been guided by a series of key general (Vision 2020 and PRSP) and sector-specific policies (NAP, 2004, and PSTA, 2005) and other relevant policy statements such as the Science and Technology Policy (2005), and an important new land law, also in 2005 (see Vol. 2, Annex 1 for more details of these policies). The number of stakeholders in the sector is by far the largest of any productive sector in Rwanda and the extent and complexity of its development problems certainly rivals those in the education and health sectors (see Vol. 2 Annex 2 for an analysis of the roles played by these sector stakeholders).

20. The development of agriculture is constrained by a serious land scarcity, with farmers forced to make extensive use very steep hillsides, highly subject to erosion. There is also serious marketing handicap due to isolation and high land transport costs. Thus the natural resource base is subject to continuing degradation due to the pressure from high population density. This has led to:

- a) Smaller individual holdings (the average farm household in most areas has less than 0.5 hectares), from which it is increasingly difficult to earn a living,
- b) Fragmentation of holdings which reduces the scope for rationalization of farming;
- c) Increased pressure on adjacent *marais* valley bottoms and other fragile land-water systems due to the declining soil fertility on the hillsides;
- d) Farmers resorting to renting land to meet their needs; and
- e) Shorter fallows and declining soil fertility.

21. A continuation of these trends constitutes a formidable development challenge, complicated by other environmental threats: periodic droughts in the East, extensive deforestation, and loss of biodiversity. High transport costs reduce the competitiveness of Rwandan exports and limit the potential for using modern inputs in raising agricultural productivity by raising their farm gate cost. Limited reliance upon productivity-enhancing farm inputs results in further soil fertility depletion and intensified pest/disease challenges, hence low and declining yields. Low yields result into household food deficits, little or no marketable surplus, and an inability to check land degradation. The resulting low household incomes further reduce the farmer's capacity for investment and perpetuate the cycle of poverty.

22. In this context, there are three primary subject matter activity areas for the future NAIS in addressing these problems:

- (i) **Improving the productivity of basic food crop and animal production systems** that are important to the food security of the entire population and its real income -- through more abundant food for producers and others in rural areas, and through relatively cheaper food for the urban population which is expected to grow from 20 % to 50 % of the population by 2020. This will have to be done primarily through

commodity-specific productivity increases, but also through the closer integration of animal and crop production systems and the spread of field-level agro-forestry practices that have dual roles in erosion control and livestock feeding.

- (ii) **Stabilizing and improving the sustainable utilization of Rwanda’s natural resource base** (i.e., land/soil and water resources, especially in regard to hillside and marais production areas). The tighter integration of animal and crop production systems, and the expansion of multiple use agro-forestry systems will obviously be important components to improving the sustainability of hillside production through better soil fertility and improved erosion control. These in turn can have strong impacts on the sustainability of production systems lower in the watershed (marais lands), but also higher yields at all hillside levels.
- (iii) **Increasing the volume and improving the profitability of commodity production that is primarily destined for market sale**, either in national, regional, or international markets. Essentially this involves increasing the number, extent and profitability of commercial value chains and further strengthening existing or emerging chains in products such as Arabica coffee, potato, rice, dairy cow milk and other milk products, and high-value horticulture for regional or international export.¹

23. The first two of these large activity areas must be considered primarily as the state (alone or with donor assistance) providing “public goods” to targeted user groups due to the difficulty of having beneficiaries directly pay for any significant portion of these research and technology transfer services. For example, the public research system must always be ready to solve urgent production problems (e.g., disease or insect attacks) as they arise, while continually working to increase per unit (per hectare or per animal) productivity on important food crops. The third area, market-oriented value chains, has the potential to be more self-sustaining or to produce a larger portion of the funding needed for its own research and outreach. There are strong overlaps and inter-actions between these three activity areas. As shown in Figure 1, these constitute the “user needs” that need to be satisfied by the evolving agricultural research and technology transfer system.

2.2 Main Problems in the Performance of the ARTT System

24. In this assessment of the current **agricultural research and technology transfer system (ARTT)**, we have concluded that the system is performing poorly in terms of what is needed for sector growth, employment and income generation, and poverty reduction. Structural and functional problems have been identified in both of the system’s main sub-components: research and technology transfer. The following nine problem areas are key and form the basis for the recommended actions in the next chapter:

¹ A possible fourth area for applied research and social action involves reducing population density on some hillsides, consolidating scattered farm parcels into larger units where some light mechanical technologies might be used (e.g. walking tractors, etc.) and where, in general, crop production intensity and profitability (to be reflected in much higher yields) can be increased. This is a topic that has high socio-political sensitivity. It will involve the application measures associated with the new land law passed by parliament in 2006, would require the extensive development of land survey skills for organizing and cadastral recording of land lease transfers, and would also require that exiting farm families receive assistance as they transit to other sectors for employment and to a more urban or small town residence. Most of this is not agronomic in nature and would probably best be handled by another part of the government working with local citizen groups. The important role for applied research would be dealing with eventual larger farm units (5-20 ha for example) and choosing a new mix of higher-value crop and livestock enterprises that can increase average per hectare productivity and profitability.

- a) Missing or inadequate **ARTT system components**,
- b) Only tentative, and **partial empowerment of the users** of system outputs in terms of participatory problem identification and system planning, and research technology transfer program execution and evaluation;
- c) **Inadequate participation of the private sector and civil society** (broadly defined) in the development and dissemination of agricultural technology in a value-chain framework, and **inadequate attention to the profitability** of farm and other levels of value-chain production;
- d) Insufficient, disorganized, and poorly prioritized GoR and donor **funding** of research and technology transfer, and lack of cost-recovery mechanisms **and financial autonomy** needed for ISAR and downstream partners to be at least partially financially self-sustaining;
- e) **ISAR is under-performing** in terms of the execution of contracted research activities, untimely transmission of results (that are also “packaged” inappropriately) to users, inadequate monitoring and evaluation of system results, and excess rigidity in dominant GoR public service procedures;
- f) There is a **lack of coordination, communication of lessons learned, and performance standards for technology transfer to farmers** across the large number of different groups involved in the transfer of technology to farmers and other value-chain participants: NGOs, Farmers’ Unions, Cooperatives, independent projects and those based at MINAGRI, private sector companies, and MINAGRI’s own priority programs conducted with District and Secteur *agronomes*.
- g) **Inadequate numbers and ill-trained staff** in key state research and training institutions (ISAR, UNR, ISAE especially) to produce the trained personnel that national plans and policies are demanding and non-governmental partners need for their work. In addition, there are inadequate incentives to retain and motivate these staff member in key institutions;
- h) The two national institutions of higher education in agriculture, **UNR and ISAE, have inadequate capacity to correctly train the scientists and technicians** who will be needed by Rwanda’s future agricultural industries; and
- i) The **decentralization** of the research and outreach system (both within ISAR and at District/Secteur levels) is not yet producing desired results and needs modification.

These problem areas have come from the ARTT system assessment that is contained in the balance of this section of the report (paragraphs 25 - 56 below).

25. The lack of effective linkages between research and extension and internal weaknesses in ISAR capacity, funding, and management have so far been the biggest hindrances to effective transmission of improved technology to producers. Research has often been conducted without considering the real needs of the farmer users (or other value chain participants). Furthermore there has been no functioning mechanism through which information on all innovations and technological solutions are assembled for use by potential users in the sector, although the Center for Agricultural Information and Communication (CICA) to be created in MINAGRI by the new Decentralized Extension Project (PVD) promises to do so.

26. In terms of the functioning of the overall ARTT process the biggest problems in the system occur once research results leave ISAR and other research partners and enter the process of dissemination, whether in pilot tests in farmers' fields or in mass dissemination campaigns (e.g., anti-erosion efforts, the recent campaign to replace existing varieties of cassava with mosaic resistant varieties). It is here that the system is most fragmented, where information flow is "hit or miss", and where system effectiveness drops sharply.

27. **ISAR Performance:** The research being conducted in the current system is only adaptive in nature, which is appropriate given (a) the state of agricultural transformation in Rwanda, and (b) the large backlog of more general knowledge of plant and animal systems, appropriate for Rwanda, which largely needs to be "fine-tuned" in order to have substantial positive impact in farmers' fields. ISAR does have severe problems in human resources, funding, internal management, and delivering on contracted research, but these are more concentrated and easily solved than the more complex real world challenges of making proper use of available technology in the promotion of specific commodity sub-sectors and the development of models of sustainable production in hillside and marais-land farms.

28. In general it is clear that the ISAR staff, over the next ten years, will need substantial strengthening (degree training and on-the-job orientation towards producing outreach material and working effectively with research users) for it to handle its mandate and respond to the three activity areas sketched out above. Its greatest relative strength is in area (i), where its basic research programs are generally well geared to what is needed for improving basic food crop production and can support improvement in widespread "local cash crops" (bananas and sorghum for local beer making, for example).

29. ISAR ability to handle integrated small farm management and watershed management, and related areas such as crop-livestock joint products and agro-forestry (area ii) is quite weak, and the established programs are not designed for ease of outreach and impact at farm level. However, the Integrated Watershed Management at ISAR has made a good start at showing the way forward in this important area. Pre-1994 work done in "farming systems research" (FSR) projects may also provide a starting point if it can be accessed.

30. ISAR is perhaps the weakest in its ability to support the development of commercially important value-chains (area iii). In some areas its technical competency seems to be responding reasonably well (such as in the tissue culture production of seed potato in Ruhengeri), but in other important areas (in coffee and tea research, for example), almost nothing has been accomplished in recent years, despite specific funding having been provided to ISAR by these industries. Nothing much is being done with ISAR's model coffee plantation and washing station at Rubona. Little or no screening and agro-ecological zone adaptive testing of potential export horticultural products is taking place.

31. **Performance of Technology Transfer Units:** As was mentioned in Section 1, government extension services were abolished in 1998 on perceived performance and cost-saving grounds. That was followed by an intense period of technology transfer experimentation by NGOs, the two new Farmers' Unions (INGABO and IMBARAGA), and by donor projects funded by the World Bank, the AfDB, the EU, and bi-lateral donors (USAID, BTC, GTZ, etc.). More recently (2005) the government reorganized the administrative map of Provinces (now 4 plus the Kigali capital zone), Districts (now 30 in number), and Secteurs (416). The Government has come to the conclusion that it needed the presence of agricultural agents (agronomes) at least at District and Secteur levels and has hired A1 level

personnel ² who work under the supervision of elected and appointed officials at those levels (all in MINALOC). Decentralized agricultural staff is needed by the state to execute national land conservation and anti-erosion campaigns, national fertilizer program with demonstration fields in every Secteur, and in general to facilitate the transfer of technology to farmers by non-governmental groups using different approaches (see Vol.2 Annex 3 for more details).

32. Officials in the MINAGRI agencies (Rwanda Agricultural Development Agency - RADA, and Rwanda Animal Resources Development Agency - RARDA) have indicated that having the approximately 450 agronomes at district and secteur levels working for MINALOC rather than MINAGRI makes some aspects of developing coherent technology transfer programs more challenging. However, this is part of the new national decentralization process and is unlikely to be changed. What will change are the working relationships between the MINAGRI staff and MINALOC agronomes when there will be a flow of ear-marked conditional grants and special project funds, training opportunities, technical information, and some operating funds for transport and basic field activities (for example, now at secteur level, for the 5 professional staff of the secteur, only one motorbike is provided for the use of the Executive Secretary).

33. In terms of core technology transfer in agriculture, the work of the RADA seed development unit (SDU) and the technical units in RARDA (for animal health and production) are indicative of the current state of affairs in technology transfer. The RADA-SDU, with 14 seed farms across the country, working relations with over 50 seed multiplication units (private farms or farmer groups) seems to be making good progress at establishing a system of certified seed producer-sellers for different priority crops, but with the exception of maize and potato, is only meeting about 3 % of the potential demand for improved seed after two years of work. Coordination committees have been formed in each commodity area for planning and performance evaluation purposes, and for setting seed prices based on cost-of production, all pre-requisites for some eventual privatization of these commercial services (additional details in V.2 Annexes 3 and 6). ³

34. In similar fashion, RARDA is making use of projects (such as PADABEL), and the flexible contracting of inseminators and veterinary care specialists to provide improved animals to farmers, for animal breeding, and for farm-level vaccinations. Refrigerators had been provided to district offices (in the offices of economic development officers, A0s, who supervise the district and secteur agronomes) for the storage and distribution of vaccines to locally-hired veterinary aids. At this basic level, improved technologies for crop and animal production are beginning to move more effectively to producers.

35. At this stage it is impossible for this team to come to any firm conclusions about the relative merits of different extension techniques being used by RSSP ("farmer-based extension, using "farmer leaders"), INGABO ("model farmers" who simply demonstrate improved crop, animal, or integrated technologies at their own farms for their *gacaca* or *mudugudu* ⁴ neighbors to see), or the extension techniques that various USAID projects (ADAR, PEARL, SPREAD, ACIDI-VOCA) have used in work with the development of fully-washed Arabica coffee. Similarly, it is hard now to predict how the flow of technology information will evolve between RARDA and RADA and the decentralized MINALOC agricultural personnel, especially

² A1s have secondary school education (either vocational or regular high school tracks) plus 3 years of specialized post-secondary technical training, generally at ISAE.

³ See also new "seed value chain" newsletter, "*Imbutu Nziza*", produced by RADA-SDU.

⁴ These two terms in Kinyarwanda both refer to local farming communities where farmers can easily get together to trade farming tips or settle local problems (*gacaca*).

with better funding of these joint efforts. However, we can come to two concluding points about the current state of extension:

- There is a general recognition of the need to have more coherent and reliable systems (perhaps along the lines of one or more those already in action) for participatory technology transfer at *cellule* and *mudugudu* levels; and
- The new decentralized extension project will be developing a more comprehensive strategy and guidelines for facilitating technology transfer to farmers.

36. Functioning of the Combined system of technology generation and transfer to farmers: As noted, most crop research is limited to adaptive research at this stage (germplasm screening, varietal selection to meet user needs - such as field testing new soft wheat varieties for yield performance and better bread-making characteristics), which is appropriate. The overall technology transfer system for crops (between ISAR and its downstream extension partners) is still quite fragile and very dependent on donor intervention to function.

37. As a first example, the facility at Kinigi/Ruhengeri for tissue culture production of potato micro-tubers (in the lab) and mini-tubers in screen houses was set up by a Dutch project two or three ago. The BTC project in RADA (to support the development a private seed industries where they make commercial sense) takes over at that point to organize additional rounds of multiplication of mini-tubers using farmer's groups and private seed multipliers. Even with this assistance, the "technology transfer system" for potatoes is only meeting 22 % of the theoretical recurrent farmer demand for quality seed potatoes. (see Vol. 2 Annex 6 for more discussion of the feasibility of breaking the production bottlenecks in this technically complex value chain).

38. A second example of donor-dependency of basic technology transfer systems is the transfer of foundation seed (for all other priority crops) from ISAR to the RADA Seed Development Unit for distribution to seed multipliers and eventual sale of certified seed to farmers. Within a year or so of the end of a previous BTC project working with the national seed service - SNS (in about 2002-3), the ISAR "seed unit" responsible for transferring foundation seeds to the old SNS had disappeared and no foundation seed was being transferred for multiplication. When the BTC AFSP project began in 2005, the ISAR seed unit was re-established and foundation seed again began to be transferred to SNS (now RADA-SDU) for multiplication.

39. Animal research appears to be even more limited. Most of what is being done in Rwanda seems to involve observational trails of the productivity of improved mixed-race animal species, feeding trials and the introduction of exotic breeds (e.g. Holstein and Jersey dairy cows, "Boer goats" from South Africa, wool sheep breeds, etc.) for genetic improvement of farm-level herds, and repopulating domestic herds. Animal health research is not covered by ISAR and only a few observational trials are undertaken at the RARDA central laboratory at Rubirizi. Most of the technology transfer that is taking place involves RARDA and NGO programs in artificial insemination, animal health campaigns, and cooperation with groups promoting the provision of improved livestock to farmers in support of campaigns such as "one farm, one cow" for milk production.

40. For horticultural crops there are no research or technology transfer systems (with a few exceptions such as Maracuja and temperate fruit tree trials) operating. RHODA has just been created in MINAGRI and newly hired staff is just starting to come to work in late May, 2007. ISAE is going to create a horticultural department that will begin training operations and industry collaboration within two years or so. ISAR also has a small horticultural unit, but it is doing more work on a donor-funded project to preserve indigenous vegetable species from disappearance, than it is on the "exotic" vegetable varieties (cabbage, carrots, etc.) that are widely produced and traded in national and regional markets, or on the flower, ornamental, or vegetable crops that have some international export market potential.

41. **Private Sector Participation:** There is relatively small private sector participation in the larger-scale, formal-sector portions of Rwandan agribusiness, as compared to the levels in other comparable, competing East African countries with tropical highland production zones: Kenya, Uganda, and Ethiopia. Most Rwandan commodity chains, with a few notable exceptions, have seen only limited growth of modern private sector companies that take an active role in the more technically complex and potentially lucrative segments of these chains. Much of the growth in recent years has been cooperative structures that have been fostered by donor and NGO development projects. These cooperatives have become the training ground for the potential independent Rwandan entrepreneurs of tomorrow, as well as serving as a means of introducing modern production and post-harvest processing technologies.

42. Given this embryonic development of formal private sector agriculture enterprises, it should not be surprising that private sector participation in technology generation and transfer has also been quite limited. It is important to note that three private or semi-private enterprises (Rwanda Flora, OCIR-Thé, and OCIR-Café) all reported having recently provided funds to ISAR for contracted research, but have received none of the contracted research output.

43. The parastatal and private firms operating in agriculture have provided some technology transfer to producers but this technology has generally come from sources other than ISAR. For example, much of the technical expertise required to set up and operate 150 washing stations for Arabica coffee mostly has come from the private sector elsewhere in East Africa, and from South America to a lesser degree. Coffee marketing expertise has come from Europe and the US, main markets for more expensive specialty coffees. The technology used in the rapidly growing milk industry has generally come "off-the-shelf" from the vast storehouse of accumulated knowledge of dairy production and processing systems in OECD countries. Rwanda Flora's production technology for roses mostly comes from the huge Kenyan export floral industry, with other key pieces of technology coming from Holland, Israel, etc.

44. **Performance of UNR and ISAE:** The Faculty of Agriculture (FACAGRI) of UNR and ISAE are the lead institutions of higher education in agriculture for the country, training graduates in agriculture and agro-industry. Student populations have been increasing rapidly over recent years. ISAE currently has over 1500 students on its 3 year Advanced diploma programs (A1) with a few of these having enrolled for an additional 2 year training to qualify with a first degree (A0). FACAGRI, on the other hand, has a student population of 359 undergraduates (A0) and 27 on Masters' degree programs in Agroforestry and Soil Management being conducted in collaboration with Wageningen Agricultural University and supported by the Netherlands Government. Laboratory facilities at ISAE have been well equipped with support

from AfDB; and the NUR (as a whole, not just FACAGRI) is to receive about US\$ 15m for capacity building and research from the Swedish Government. Research output in both institutions are low.

45. Relatively speaking, ISAE (a much smaller and newer institution) is much closer to adequately performing its role in technical agricultural manpower training and commodity industry support, than UNR is to performing its more demanding role of training the research scientists who will be able to fit into the “results-driven” world of 21st century agriculture. UNR is somewhat hampered by its traditions and more elitist history as the only institution of higher learning in Rwanda (until the 1980s), and seems much less sure in how to proceed in meeting complex user needs requiring a blend of good science training with the development of business-oriented entrepreneurial skills useful in private sector development.

46. These institutions of higher education in agriculture, especially NUR, lack proper laboratory and research facilities and investments need to be made to ensure that students acquire the necessary practical skills and that more sophisticated lab services can be made available to some potential clients on a fee-for-service basis until these can eventually be offered by the private sector. However, before the Government makes large investments in specialized laboratory equipment, an inventory should be made of the specialised equipment that is already available within the various institutions across Rwanda.

47. The farming and agro-industrial investor community need assistance - business advice and information on technology selection and purchase, marketing, finance, project analysis and business plan preparation, obtaining credit and training for specific sub-sectors (value-chains).

48. Building institutional capacity of UNR and ISAE to respond to these problems is a key strategy that will facilitate the ARTT system to better respond to the national priority areas for agricultural transformation, namely, *“Linking up extension and research to the farmers; targeting commercial production; undertaking skill training for improvement of agricultural sector players; promoting development of agro-based enterprises; strengthening agriculture education in schools; and sensitizing the public on the importance of agriculture in the economy”*.

2.3 In Sum: A Fragmented, Poorly Coordinated ARTT System

49. The current system is centred on ISAR for the production of improved agricultural technologies, with outreach being handled on a somewhat “hit or miss” basis by a wide array of mostly non-governmental institutions: donor-funded projects, NGO’s, farmers’ unions, commodity-specific cooperatives, private sector firms. The system is characterised by inadequate coordination and inadequate performance by many partners upstream and downstream from the farmer and his use of improved technology for production.

50. In the future, given a broader list of stakeholders playing enhanced roles as system partners, increased human resource capacity in partner institutions, a broader use of flexible collaborative groupings and contracting/sub-contracting mechanisms for problem-solving, and improved performances by key supporting actors (input supply, financing, etc.), an increased

number of partners will have larger direct roles in the agricultural research process (See table 1 in Annex 2 of Vol.2), but with ISAR still playing a central or core system role. For example, we anticipate that the scientific personnel at the Higher Learning Institutions (HLIs) will be more heavily involved in competitive problem-solving research networks than they are today.

51. The system “outreach role” currently played by MINAGRI (through RADA and RARDA) and the decentralized agricultural personnel of MINALOC is much smaller than the role MINAGRI played in the “chain-of-command extension systems” of the past (pre-1998). In coming years the roles of MINAGRI and MINALOC probably will both grow in absolute terms, but the functions performed will be more to coordinate, facilitate, and in some cases, finance technology transfer in coordination with the non-governmental institutions active in direct contact with farmers. This will be coordinated and facilitated at district and sector-levels by the agricultural personnel of MINALOC, if those personnel receive adequate logistical and pedagogic support from MINAGRI and budget allocations from central government allocations to the districts, which is not the case at the moment. This will begin to change with the start-up of the “decentralised extension” project with ICT-heavy activities in Kigali, personnel training, and pilot extension facilitation activities at district and sector levels.

52. Is dispersion of agriculture across many ministries a system problem that needs attention? The mission notes a staggering dispersion of public sector agricultural capacity and responsibilities across a large number of GoR ministries. In recent years this process has accelerated as MINAGRI lost key units to MINITERE, MINALOC, INS, MINICOM, etc. and has become dramatically smaller in size. One question that is sometimes raised is whether reconsolidation of functions in MINAGRI would improve coordination, enough to compensate for the cost of undertaking these political battles? The basic answer is that this would most likely not be worth doing. The vision of the future agricultural research and outreach (ARTT) system is that it will be made up of numerous networks of institutions that are put together to solve problems, and held together by funding from governmental and private sources. In this vision, it is less important where in the GoR ministerial organizational chart system partner institutions are located, as long as they do their planned and contracted jobs.

2.4 Other Missing Pieces to a more Complete National System

53. As better performance is required from the ARTT system, the GoR and its economic development partners need to give greater attention to completing the array of key national sector development institutions that are needed promote strong growth of Rwandan agriculture oriented towards increased productivity and satisfying consumer demands in national, regional, and international markets. Among the “missing pieces” in this more complete set of institutions are the following.

54. **Need for Value Chain Production and Marketing Cost Data Collection and Analysis for Better Agricultural Policy Making:** In addition to the highly variable performance of ISAR’s technical commodity work in commercially important agricultural product areas, the NARS system as a whole seems to have virtually no capacity:

a) to produce and analyze farm-level cost-of-production data,

- b) to gather the information needed to compare commodity productivity across agro-ecological zones (for some eventual outreach encouragement of regional specialization in production), nor
- c) to conduct basic comparative and competitive advantage analyses to correctly inform policy decision on key questions of:
 - i) Investment prioritization,
 - ii) Whether import-substitution production in cereals (maize, wheat, and rice), domestic oil seeds (vs. imported palm and vegetable oils) makes economic sense,
 - iii) In which horticultural markets does Rwanda have some competitive advantage and what commodities lend themselves to production in variations of “out-grower” models that might fit with pilot efforts to improve per hectare productivity?
 - iv) For international markets the types of competitiveness analyses done by groups such as OTF, and more the technically sophisticated USAID projects such as PEARL, ADAR, SPREAD, and ACDI-VOCA’s coop work in coffee, all need backing from good cost-of-production data collection, and applied research in the biological components of the value chain and post-harvest processing.

55. Legal and Regulatory Environment for Agribusiness Development: This is an important area for the further development of all agribusiness in Rwanda. The need for investment in human and institutional capacity building in this area is illustrated by:

- a) The lack of a comprehensive food law in Rwanda, which would serve as the basis of developing fresh and processed food standards, inspection routines, sanctions for violations, etc. This is essential for the further development of certain value-added processed food industries (dairy, canned and bottled juices, processed and packaged food products based on cereals, legumes, cassava, etc.)
- b) Need for work on plant protection regulations (under the International Plant Protection Convention), especially concerns about bio-technology and scientific plant gene manipulation, already wide-spread in both developed in developing countries;
- c) Phyto-sanitary regulations and laboratory testing capabilities (e.g. the new “Rwanda Horticulture Export Standards Initiative” project will work in this area over the next two years)
- d) Ability to generate Eurepgap, and Organic certifications in country for being able to access

56. General business climate for private sector development and the encouragement of FDI (details in Vol. 2 Annex 6). There are several areas of concern here. First, despite the institutional strengthening efforts that have taken place at RIEPA and the RPSF over the past five years, Rwanda is still viewed by outsiders as a difficult place to do business. Three areas that need substantial work:

- a) Rwanda must reform its business-related laws and regulations so as to merit a better score in the World Bank’s *Doing Business* index, in 2007 ranked 158th out of 175 countries classified;

- b) The banking sector is in bad need of reform. GoR needs to work with to encourage it to become a more important and vital partner in agricultural sector growth; and
- c) Private sector enterprises and associations need assistance to play a stronger representational role in a wide range of arenas, in order to help guide the flow of government and donor assistance, so as to achieve better results. While representational “economic democracy” can not be forced from the top down, barriers to stronger participatory system can be identified and removed over time if government wishes to create true partnerships with the private sector.

3. ACTION PLAN FOR IMPROVING AGRICULTURAL RESEARCH AND TECHNOLOGY TRANSFER

3.1 Strategic Vision

57. Rwanda recognizes that much of the technical knowledge it needs to improve the well-being of farmers and diversify the economy is already and in wide use outside Rwanda. Unfortunately, this essential knowledge is not widely available in easy to use “packages” in Rwanda. From this perspective, the STI capacity building challenge in agriculture is to train farmers, entrepreneurs, engineers, technicians, scientists and teachers to find appropriate technologies, import them, adapt them to local conditions, and use them to solve local problems and produce and market higher value, more knowledge intensive goods and services. This, in turn, means that Rwanda needs to improve the quality of its applied engineering and scientific research institutes as well as its technical and vocational education. It will also have to focus more of their teaching, training and research efforts on using this existing knowledge to develop, produce, and deploy such simple, low cost technologies. In addition, for enterprises to be able to exploit the competitive opportunities generated by appropriate technologies, their workers need to have the requisite skills to use new technology or perform more complex tasks. Enterprises also need to have the organizational and managerial skills and technical competence to invest, innovate, and compete on the basis of quality rather than cheap labor.

58. The Strategic Plan for the Transformation of Agriculture (PSTA) envisions that the current NARS should be transformed into:

“A client-oriented, market-driven national agricultural research and outreach system that generates and disseminates research outputs contributing to improved income and food security to the population, and transformation of agriculture into a productive, high value, market oriented sector with forward linkages to other sectors while preserving the environment.”

59. The vision is expected to materialize through pursuit of a mission that will lead to:

“The generation, adoption and dissemination of appropriate and demand - driven technologies, knowledge and information through an effective, efficient, sustainable, decentralized and well co-coordinated agricultural research system”

60. This strategy proposes 15-20 year transformation of the current agricultural research and outreach system into a future National Agricultural Innovation System (NAIS). The future NAIS will be a more flexible system of problem-solving partnerships between ISAR (and other potential producers of agricultural research) and different providers of technology transfer and advisory services to agricultural producers (and others upstream and downstream in the value chains), in order to expedite the dissemination of improved technologies and information to users. These collaborative and contractual networks will focus on optimizing the volume and value of production from specific commodity value chains and/or the solution of pressing problems in important food security commodity areas and in natural resource management.

61. This evolving system will be judged on its ability to increase per capita and per

hectare farm income, thus contributing to the national goal of reducing poverty. This strategic reflection should be periodically updated and revised by MINAGRI, and groups of farmer representatives or other agro-industrial value-chain users, meeting with research producers and technology transfer specialists.

3.2 Proposed Problem-Solving Actions

62. In order to address the nine problem or issue areas identified in the ARTT assessment (section 2.2 above), we are proposing a set of actions for consideration by the GoR and its partners in development. There is of course a high degree of inter-relationship between these problem areas (e.g., inadequate human capacity and operating budgets, and ability to undertake research and technology transfer to farmers). In addition, there is need for substantial debate to refine these ideas by ARTT system stakeholders. This process will begin with their presentation and discussion at the study's validation workshop and will need to continue in subsequent meetings to further refine the action plan.

3.2.1 Adding or Strengthening Key ARTT System Components

63. To meet the problem of missing institutional and functional pieces to a more complete national ARTT system, the following system needs have been identified:

Need 1.1: The greatest identified needs for capacity strengthening in ARTT system are in existing or future programs that are related to (a) integrated farm management and integrated watershed management at the community level, and (b) support to the development of commercially attractive commodity value chains for national, regional, and international markets.

Need 1.2: There is an almost total lack of systematic data on the cost of producing commodities and consumer products in value chains. This information and related comparative and competitive advantage analyses is required for informed policy decision-making in support of government and private sector investment in the sector.

Need 1.3: The legal and regulatory frameworks -- required for the development of modern food processing, animal and crop production systems using improved germplasm and breeding stock (coming from bio-tech gene manipulation and more traditional breeding approaches), and enhancing the capacity for Rwandan exports to meet required quality (including organic and fair-trade certification) and phyto-sanitary standards in target markets -- are only very partially in place.

64. The following actions are proposed to meet those needs:

Action 1.1: ISAR needs to re-engineer and re-prioritize its research program so as to be able to produce (in addition to core work on the improvement of food security crops) more applied research results that provide improved models for:

- a. Integrated small-farm systems with a greater emphasis on animal-livestock integration, agro-forestry, and enterprise selection for higher farm income;
- b. Community level integrated watershed management programs in cooperation with district and secteur governments and local community organizations;

c. Improved technology generation and delivery to help solve bottleneck problems in the further development of traditional cash crops and newer non-traditional exports in high-value horticulture.

Action 1.2: A specialised applied research unit to coordinate **cost-of-production data collection** (to be implemented by the new agricultural data collection unit in the NIS), and **comparative and competitive advantage analyses of Rwandan agricultural value chains** should be created and funded as a core program to generate data and information to guide public and private sector investment decisions. The location of this unit in GoR institutions needs to be carefully chosen so that it can play its policy-advisory role in an impartial manner.

Action 1.3: In association with the new WTO-funded “Rwanda Horticultural Exports Standards Initiative” to be located in MINAGRI-RHODA, a comprehensive study and action plan should be developed for establishing the needed legal and regulatory framework for both domestic fresh and processed food products and those quality, origin, and phytosanitary standards required to be competitive in various regional and international export markets.

3.2.2 Empowering the Beneficiaries of Agricultural Research and Outreach

65. Building functional economic democracy for business development in Rwanda requires responding to the following needs:

Need 2. 1: There must be greater participatory pre-season joint planning and in-season operational coordination between ISAR and:

- Other sources of in-country scientific competency and research participation, specifically UNR, ISAE, KIST, and trained personnel scattered across other institutions or acting as independent consultants;
- The key groups in transmitting technology to farmers: NGOs, farmers’ unions, donor projects, and the emerging facilitation capacities of the MINAGRI agencies (RADA, RARDA, RHODA) and District-level MINALOC agricultural personnel;
- The partners of specific commercial value chains (coffee, tea, potatoes, rice, dairy industry, and high-value horticulture commodities -flowers, vegetables, etc. - as they develop). The need for improved coordination and timely joint actions among partners in higher-value production and marketing chains is even more critical. For example the coffee industry, Rwanda’s number one export, has been plagued over past years with an inability to provide key inputs on time and not being able to mobilize adequate seasonal credit for coffee purchasing.⁵

Need 2.2: Farmer, farm group, and value-chain stakeholder participation is required in the research and technology transfer system in three key areas: priority setting and planning, funding (including financial accountability), performance contracting, and the monitoring and evaluation of results achieved.

66. The following actions are proposed:

⁵ Ripe coffee “cherries” must be picked, purchased, and undergo skill-intensive processing steps (depulping, fermentation and washing, repeated sorting for quality, drying, and parchment removal) in a fairly narrow time window in order to produce good quality “green coffee” that will command high prices on world markets.

Action 2.1: Enlarge farmer and other value-chain stakeholder participation in annual research planning and feedback meetings of ISAR and other key ARTT institutions (RADA, RARDA, RHODA): (a) planning meeting to agree on the main research programme to be supported with core funds and competitive funding, and (b) a review meeting to consider achievement of results and progress towards meeting set goals.

Action 2.2: Create a client-led **National Agricultural Research Board (NARB)**, as a sub-structure under the proposed National Council on Science, Technology and Innovation in MINISTR, to undertake the following functions: ⁶

- (i) review performance in the technology generation and transfer system in agriculture;
- (ii) provide general priority orientation for the annual research and outreach programs of ISAR and other research units as reflected in national core budget allocations;
- (iii) advise on the allocation of competitive research funding (from the National Research Fund and the Innovation Support Funds), based on demonstrated competence (including research performance, skills mix of teams) by ISAR and other research units and the potential economic impact of the identified problem area and quality of proposed methodologies.

The NARB should receive independent synthesis of expressed agricultural research needs from the constituents of the research-outreach system - farmers and farmer groups, scientists of ISAR other relevant research and training units (eg. KIST, ISAE), and downstream technology dissemination units coordinated by RADA, RARDA, and RHODA.

Action 2.3: Institute participatory monitoring and evaluation processes for assessing the effectiveness, efficiency and impact of research services and outputs by involving all stakeholders (farmers, inputs suppliers, processors, marketing agents, local governments and central government). This will need to be done on a pilot basis to develop a workable, functional model.

3.2.3 Promoting Profitability of Agriculture and Private Sector Participation

67. Conversion of Rwandan agriculture to a more modern, market-oriented sector will take decades. However in the next five years it will involve meeting the following needs:

Need 3.1: In conjunction with Action 1.2 above -- collection and analysis of cost and return (profitability) data - there is need for this information to be made widely available and used in policy-making debates and decision-making. This public-sector, more-objective analysis, needs to be combined with presentations made by commodity groups seeking public-sector and/or donor assistance.

Need 3.2: The GoR needs to undertake analysis and measures to improve the climate for foreign and domestic private sector investment in modernizing value chains. Measures need to be taken to encourage the growth of private firms in most crop, animal, and horticultural value chains.

Need 3.3: The existing groups that represent the Rwandan private sector (RPSF and its 12

⁶ An alternative name might be: the NATAB (National Agricultural Technology Advisory Board). The GoR should choose a name that correctly reflects the Board's final mission objectives.

commodity-oriented chambers) and promote greater private sector investment in high-value exports (RIEPA) need to be more involved in priority setting in the NARB, and component units such as ISAR, RADA, RARDA, and RHODA.

68. The following actions are proposed:

Action 3.1: We suggest that the NARB base at least part of its deliberations on a periodic (every 3-4 years) “cost of production, comparative advantage, and profitability” report (with annual updates on factors - prices, market disruptions, etc. -- that undergo more frequent change). This report would be furnished by the new unit to be created in Action 1.2 above.

Action 3.2: The GoR, through a NARB sub-committee (in conjunction with RPSF and RIEPA) needs to continue to monitor problems and improvements in the “investment climate for agri-business” by:

- Making significant progress in eliminating barriers to investment in using improved technologies;
- Improving relative performance on the World Bank’s set of “doing business” indicators,
- Requiring better performance from financial and credit institutions in terms of providing seasonal and longer-term investment credit,
- Adequately protecting Intellectual Property Rights (IPR) in agricultural technology,

Action 3.3: **Innovation Support Funds (ISFs)**, funded by GoR and donor funds, that would serve as a source of matching grant funding for specific proposals made by partnerships between private companies and local production groups. The fund would serve to help demonstrate “proof of concept” on a pilot basis, to be linked in later stages by commercial loan guarantee funds and “business incubator” approaches to strengthen the new firms producing for national, regional, and international markets.⁷ The proposed Agricultural Guarantee Fund could be a source of funding for the ISFs.

Action 3.4: Developing approaches and mechanisms for organizing and linking poor producers to markets for high-value products. Through the ISFs, the Private Sector should be supported in its efforts to develop supply-chain management and out-grower production systems for particular groups of commodities/ technologies.⁸

Action 3.5: Support the development of private seed multiplication and distribution companies where there is sufficient farmer demand (e.g, seed potatoes through tissue culture).

As an alternative, MINAGRI and other partners might consider the creation of one or more for-profit private sector “share companies”. In these companies, shares would be proportionately owned by a combination of individual farmers, business persons, farmer’s unions, seed multipliers, commodity-specific cooperatives, and other private sector companies in the input business. This distribution company would be adequately capitalized, professionally managed, and expected to turn a profit for its share-holders in its commercial input sales through a network of stores convenient to farmers.

⁷ A similar approach was used by a consortium of donors earlier in the development of Kenya’s export horticultural industries (this described briefly in Labaste, WB, 2005).

⁸ The Rwanda Flora PILOT proposal, currently being circulated, is a good example of such thinking.

In addition there is need to develop sustainable input supply systems (especially for seeds and fertilizer) for areas not well-covered by private companies. Producer groups should be facilitated to organize themselves and make links with research, private companies and financial institutions to make this happen.

Action 3.6: Conduct a long-range planning study of Rwanda interest in and potential to facilitate access to and safe application of modern biotechnology, where it offers solutions to problems of high priority to poor producers and/or consumers. Application of biotechnology tools for food production has raised complex issues of biosafety, food safety, bioethics, and access to proprietary science. Access to proprietary technologies in benefit of poor producers and consumers, and negotiation of IPR regimes that provide protection to indigenous knowledge and technologies will be an issue.

Action 3.7: There are opportunities in Rwanda to have more “value chain-led” development of the research agenda. (See Vol. 2 Annex 6 for several examples).

2.3.4 Funding and Financial Management Autonomy

69. Confronting the need for the ARTT to be more adequately funded and gradually given more financial autonomy as it demonstrates its ability to handle the additional responsibility will require responding to the following needs:

Need 4.1: ISAR and ARTT partners need to diversify and regularize their sources of funding from the GoR, donor partners, regional and global sources of collaborative research funding, the private sector, and sources of self-generated funding. This needs to be at levels adequate to accomplish assigned mandates.

Need 4.2: ISAR needs to have greater real financial management autonomy so that it can develop potentially benefit more systematically from commercially profitable agricultural services (tissue culture, soil testing, R&D efforts in post-harvest processing, etc.

Need 4.3: ISAR needs to make better use of its abundant land and physical infrastructure resources at different stations, now heavily underutilized at most stations (with some exceptions, such as the Ruhengeri in-town portion of the Kinigi station)

Need 4.4: In line with GoR decentralization policy there is need for creating an ARTT funding mechanism (to be used at District level) that can attract greater support from private sector and district government partners.

70. The following actions are proposed:

Action 4.1: A careful diagnostic study needs to be undertaken to achieve to provide an initial detailed response to needs 4.1 and 4.2 above. The study should investigate several key topics, such as:

- How ISAR can make more “results-oriented” budget requests for core and supplemental funding for the GoR and from other ARTT partners;
- How more financial autonomy could be achieved, so ISAR could develop some “profit centers” that would generate support funds;
- Whether overhead rates are sufficient to maintain the Institute’s physical plant and pay some portion of routine operating costs.

Action 4.2: ISAR needs to inventory its physical plant resources and land base with the objective of making fuller use of those resources to:

- Gain collaborators (contractors) who can contribute to the applied research program while also producing profits for themselves and land or facilities rents (income) for ISAR; and
- Allow ISAR to maintain long-term control over those resources for future expansion of the scientific research program.⁹

Action 4.3: In conjunction with actions 4.1 and 4.2, ISAR needs to separate its potential money-making commercial agricultural services (e.g., commercial soil testing, vegetative propagation of some tuber and fruit tree species, tissue culture production facilities) from its scientific work. In some cases these currently share the same laboratory facilities and technical personnel with the research program. There are two main options for bringing about this functional separation: (a) keep them within the ISAR structure for reasons of rational facilities sharing and for revenue generation; or (b) spin them off as private sector businesses, completely separate from ISAR or with some collaborative agreements that make financial sense for both parties. Option (a) will only be possible if ISAR receives more independent financial management autonomy. In option (b) it would probably make sense for the enterprises targeted to provide these services be created on a “competitive incubator approach” where potentially viable private sector companies or technical cooperatives¹⁰ can be helped to grow to the point where they can commercially provide the desired services.

Action 4.4: ISAR should be able to play a partner role (on a full cost-recovery basis) in the functioning of a “business incubator” program for export agri-business. Since the ISF (presented in action 3.3 above) would allow for risk-reduction cost-sharing at the concept development stage, ISAR could be viable, cost-effective partner by being able to provide low-cost access to potentially available land, buildings, and scientific personnel.

Action 4.5: Establish an agreed formula for allocating funds from the National Research Fund for agricultural research and technology transfer. The possibility of creating an independent Agricultural Research Trust Fund and regional ISFs (possibly based on the three agro-ecological zones) should be explored.

Action 4.6: ARTT system partners should consider the creation of regional ISFs and investment incentives for attracting local (District) administrations and private sector to contribute towards the funding of research and technology transfer.

3.2.5 Improving ISAR Institutional Performance

71. Improving ISAR’s performance over the next five years will require meeting the

⁹ This idea came to the team while touring the large, virtually unused Songa livestock research station. Part of this station has been ceded temporarily to the RDF which is using it for a cattle and/or dairy ranch. RARDA and ISAR could jointly design a program to seek private livestock farmers who could breed improved diary cows at Songa for domestic sale/distribution as a money-making alternative to the current expensive importation of these animals. By maintaining good records, this commercial activity could also play some role in developing a more substantial ISAR applied livestock research program.

¹⁰ Or something like “GIE’s” *Groupements d’Interet Economique*, a relatively new form of legal business structure in francophone African countries, that seems to be appropriate for fostering start-up companies.

following needs:

Need 5.1: ISAR needs to do a better job at satisfying its research clientele. It can not continue to accept contracts from various national partners and then fail to deliver on those contractual obligations.

Need 5.2: ISAR needs to become more of a “learning organization” where, with the help of partners, it critically evaluates its own performance in period “t” and, as a consequence, modifies its operating procedures as a consequence in period “t+1”.

Need 5.3: ISAR must become a more nimble, flexible and entrepreneurial organization if it is to remain as the privileged partner in agricultural technology generation.

Need 5.4: MINECOFIN rules on GoR budget use need to be more flexible to allow ISAR to fill urgent staff needs.

72. To meet these needs, the following actions are proposed:

Action 5-1: ISAR needs professional technical assistance to develop policies and staff training modules for “client-satisfaction” in its contractual arrangements with international partners, and Rwandan parastatal and private sector companies. This will be especially important if it anticipates playing an important role in the emerging HVH export value-chains.

Action 5-2: Once ISAR can achieve an adequate core budget to pay its staff correctly, maintain its physical plant, and assure basic functioning of priority research functions (as outputs of Action 4.1), it should be able to think more creatively about how to engage in full-cost recovery problem-solving research with a variety of partners and to more aggressively market its capabilities. This will also involve taking the following measures:

- Provide a clear categorization and prioritization of research into strategic, basic, applied and adaptive research, including definition of the aspects of research that are of “public good” and those where the private sector is most suited to fund.
- Promote the use of innovative research approaches by organizing multi-institutional and multi-disciplinary research partnerships in form of groups/teams to be responsible for specific research themes at the national and local levels.
- Promote greater co-operation and collaboration with international research institutions, and donor-funded projects (such as the RSSP-funded Integrated Watershed Management Program) so as to enhance utilisation of the already existing modern techniques, technologies, skills and information.

Action 5-3: ISAR needs to become the promoter and leader in advocating for Competitive Funding Mechanisms to be used for more targeted problem-solving research project funding. To do so, it must itself be competitive in terms of meeting client needs and delivering results on a timely basis, and in a non-academic format that lends itself to technology transfer to users. To do this we recommend that experienced outside consultants conduct a critical audit of the non-core contractual research conducted by ISAR over the past two years and draw lessons learned and prepare in-house training program to improve performance.

Action 5.4: A diagnostic study should be undertaken to explore how ISAR can be given flexibility to access funds allocated for salaries and allowances for vacant full-time staff positions. These funds can then be used to contract private sector research partners and temporary/contract staff and interns to fill skill gaps and also take advantage of complementarities and synergies arising out of appropriate private-public collaboration.

3.2.6 Improving Coordination, Methods and Performance Standards

73. Improving performance in technology transfer will require attending to the following:

Need 6.1: Devise methods for improving coordination among MINAGRI (and its component Agencies), and the decentralized agricultural personnel at MINALOC, and the CSO institutions that are involved in transmission of improved technology to farmers;

Need 6.2: Evaluating the success and failure of different approaches in transmitting technology to end users in different types of farms and different value chains; and

Need 6.3: General performance standards for delivering improved technologies to both small-scale, limited resource and larger-scale, more commercial farms and business units in different value chains.

74. To meet these needs, the following actions are proposed:

Action 6.1: In collaboration with BTC PVD project, and other ARTT efforts, provide support as needed to strategic one-off efforts to promote better system coordination, comparative results evaluation, and the drawing of lessons learned.

Action 6.2: Encourage all ARTT units to contribute to the new MINAGRI CICA information databases and the creation and maintenance of its dissemination website. This can be facilitated by using periodic questionnaires and through workshop training.

Action 6.3: MINAGRI-CICA to develop and disseminate standards for “public service” TT services, and those for circumstances where partial and total cost-recovery is justified. The advantage of the latter is to encourage some cost-recovery by CSO’s or in the commercial cases of potential total cost recovery, the development of private sector business development services (BDS).

Action 6.4: Develop and disseminate models for CSO and private sector agricultural BDS delivery to groups targeted by geo-location, commodity, size of enterprise, ability to pay, category of assistance needed, etc.

3.2.7 Developing and Managing Human Resources

75. Developing and managing the human resources required for better results from Rwanda’s ARTT system will require meeting the following needs:

Need 7.1: Implementation of high quality, effective, efficient and sustainable research and extension services requires that the implementing institutions and agencies have sufficient human resources in terms of numbers, knowledge, skills and experience, as well as

their strategic deployment. Such people are highly marketable. To retain them and minimize the rate of turnover, especially in public institutes, they need to be motivated and well remunerated.

Need 7.2: Across Rwanda's major institutions of agricultural research and higher learning (ISAR, UNR, and ISAE) there are desperate personnel shortages. So one of the biggest (and most expensive) one-time needs to be met is providing higher degree training for tomorrow's scientist and agricultural educators, the recruitment of temporary staff, and upgrading the training of the existing staff to higher qualifications and new skills.

76. The following actions are proposed:

Action 7.1: Carry out a training needs assessment of the staff of key public and private institutes with important research and training role so as to formulate comprehensive training plans and programs including advancement of scientific knowledge, instructional methodologies, socio-economic research and participatory methods in problem identification.

Action 7.2: Increase liaison between the training institutions and research/advisory service providers by establishing "demand committees" through which the training institutions can get ideas regarding future human resource requirements basing on the demands for research and extension.

Action 7.3: Encourage and support training institutions to conduct more cost-effective "sandwich courses", in which students spend some time in practical research within research service provider and other commodity-specific organisations.

Action 7.4: Adjust (raise) the remuneration of academic, scientific and technical staff (salaries, wages, and allowances) so that it is comparable to what is offered in similar public institutions.

Action 7.5: Explore other avenues of motivation and remuneration of staff, such as retention of a defined percentage of revenue from research contracts and consultancies in which the particular staff are involved during implementation, for performance/achievement awards, paid sabbaticals, etc.

Action 7.6: Develop and establish scholarship, cost-sharing and education loan schemes and programs to enable the existing and prospective research scientists, including those in the private sector, to improve their knowledge and skills.

3.2.8 Capacity Building at UNR and ISAE

77. The needs for and consequent actions for capacity building at the two key institutions of higher education in Agriculture must address the following specific needs:

Need 8.1: Enhance the competence of UNR and ISAE graduates to better meet the needs of the Rwanda producers, entrepreneurs and agricultural development "architects";

Need 8.2: Provide opportunities for lower-level agricultural professionals (A2), farmers and agro-businesses personnel to participate and benefit selectively (in a "continuing education" mode) from higher education and applied research;

Need 8.3: Establish and strengthen linkages and partnerships within Rwandan institutions and with other institutions at national, regional, and international levels in order to promote cooperation in training, research and out-reach.

78. The following actions are proposed:

Action 8.1: Provide financial support for specialist post-graduate training and skills upgrade (sabbaticals, study visits) for ISAE and FACAGRI staff. At least 80% of all academic staff should be trained to the PhD level. Training to PhD level is estimated to cost about US\$ 40,000 per trainee.

Action 8.2: Establishment/rehabilitate at NUR/FACAGRI and ISAE properly equipped specialist teaching and research laboratories and field facilities in order to increase/introduce more practical training into each institution's curricula. Approximately 1500 m² of space each costing US\$ 500,000 is estimated per institution.

Action 8.3: Develop A0 and A1 courses to become more practice-based (ISAE has developed a competence-based curriculum for its training. This and its degree program need to be reviewed against the requirements of the newly established National Qualifications Framework) and specialised (in the final year) by attaching students to gain work-experience in 'production units' established at ISAE/NUR or operated by the private sector. The participating private-sector units would be financially supported to also serve as demonstration centres for the industry. The institutional units would be developed as "self-financing" centres in the long run.

Action 8.4: Encourage ISAE and UNR to continue to develop expanded "continuing education services" to the private sector agri-business community, through short (competency-based) courses, distance education and field extension activities;

Action 8.5: Introduce short modular courses and in-service training for professionals and practitioners in the ARTT system. The introduction of the courses would require the design of a 'packaged' curriculum and the resources and training necessary for their implementation. The costs for developing a new course are estimated at US\$ 25,000 which includes national and international expertise to bring the required materials together. This curriculum outline can then be utilised by the various institutes for a course on appropriate technology.

3.2.9 Making Decentralisation Work in the ARTT System

79. In recent years there seems to have been some hesitation in ISAR about how best to respond to the GoR's clear intention to devolve much of agricultural development planning and implementation to the level of the 30 new districts. In order to improve performance ISAR must respond to the following needs:

Need 9.1: ISAR currently operates three-level management structure (HQ-Center-Station). This "decentralisation" has neither created the desired institutional autonomy nor promoted better contact with or control by users groups. An alternative approach is needed.

Need 9.2: ISAR needs to figure out it how will effectively link its applied research capacity to the needs of three intermediate groups and one large final group of "technology users": (a) MINAGRI RADA, RARDA, and RHODA extension programs, (b) the 450 decentralized MINALOC

agronomes at district and secteur levels who will act largely as extension facilitators or contractors; and (c) the many CSO and donor project organizations that are funding some technology transfer activities directed (d) the users: farmers (most small but a few larger commercial farms developing) and other value chain participants.

Need 9.3: The intentions, mechanisms and options for RADA-RARDA-RHODA collaboration with the decentralized MINALOC structures have been spelt out in the numerous laws and guidelines. However, the implications of these to the real operational processes are not adequately internalized by all staff and players in the system.

80. The following actions are proposed:

Action 9.1: ISAR would be well-advised to adopt a more “networked approach” with greater user participation and linking of resources (inputs) to results (outputs) by establishing and maintaining institutional models that provide a level of autonomy to public sector research institutions that enables them to operate more efficiently and effectively, and that facilitate the rational growth of the private sector is desired. The establishment of strong linkages between ISAR (and other research service providers) to the MINAGRI (RADA and RARDA) and MINILOC technology extension efforts implemented at district and secteur levels is still in transition. However, the MINAGRI agencies (RADA, RARDA, and RHODA) can provide the resources needed to permit these agents to play facilitation and sub-contracting roles with local service providers.

Action 9.2: The issue of what is possible in terms of MINAGRI agency collaboration with the “decentralized” budget for agriculture at district and secteur levels, obviously depends on the size of that budget, the degree of flexibility in collaboration coming from the two sides (MINAGRI and MINALOC), and the potential for the centralized Kigali agencies to access other resources which could be committed to joint projects.

Action 9.3: Promote the formation and/or strengthening of (clients) farmers’ groups at various levels of local governments, in collaboration with other institutions operating at those levels, through which research needs will be articulated.

Action 9.5: Empower local governments, farmer groups and commodity value-chains with resources (funds, infrastructure) to enable them demand and contract research service providers, so as to solve location/commodity-specific problems and improve the performance of the transmission of improved technology (outreach).

4. ACTION PLAN IN TABLE FORMAT

81. The action plan developed in Section 3 is summarized in tabular form in Table 2 on the following five pages. This is to facilitate its use for other planning purposes, such as consideration of specific actions for funding under the EDPRS, now nearing finalization by the GoR and its development partners.

82. At this point the action plan is largely only a product of the three consultants engaged by the World Bank to undertake this work. It internal logic and specific proposed actions need to be subject to presentation and debate among Rwanda ARTT system stakeholders, first at a more restricted “in-house” workshop in Kigali, and later in sessions with larger numbers of participants, so as vetted as widely as possible and to receive maximum constructive criticism.

Table 2: Draft Action Plan for Improving Rwanda’s Agricultural Research and Technology Transfer System

Problem Area	Needs	Proposed Actions	Indicative Costs (in US \$ '000)
1. Important missing ARTT system components	<p>1. More capacity in (a) integrated farm and watershed management, and (b) support to modernizing value chains</p> <p>2. Cost of production data and DRC–type analyses for better national priority setting</p> <p>3. Better legal and regulatory framework for modern domestic and export-oriented agribusiness</p>	<p>1.1. Consulting assistance for ISAR to re-engineer its research program and priority setting</p> <p>1.2. Fund creation of a pilot unit (location TBD) for 3 years in cost of production data collection and analysis, and production of policy-relevant outputs</p> <p>1.3. In cooperation with MINAGRI, RHODA, WB, and new WTO horticulture standards project, determine priority list for needed studies (bio-technology and GMO policies included), and fund priority ones not covered from other sources (Also see action 3.6 below)</p>	<p>\$ 60</p> <p>\$ 500</p> <p>\$ 140</p>
2. Only very partial empowerment of technology users	<p>1. Better participatory pre-season priority planning and post-season results evaluation for ARTT at central, commodity-specific, and decentralized levels</p> <p>2. An advisory structure focused on ARTT to advise the MINSTR National Council on STI</p>	<p>2.1. Build farmer and other stakeholder participation planning and performance evaluation into the annual planning and evaluation cycle of the key ARTT institutions (preparatory assistance, additional meeting costs) two years</p> <p>2.2. Create and fund client-led National Agricultural Technology Advisory Board (NATAB) to: -- review progress in technology generation and transfer (with help from Boards for RADA, RHODA, RARDA, ISAR, ISAE, KIST) and advise the National Council on STI; -- provide priority orientation for all national ARTT units; and -- advise on criteria for the allocation of non-core, competitive funding of ARTT from the proposed National Research Fund</p> <p>2.3 MINAGRI to develop methods for participatory ARTT monitoring and evaluation of technology generation and transfer and provide training modules for use by CSO partners.</p>	<p>\$ 200</p> <p>\$200</p>
3. Limited participation of the private sector and CSOs in modern agri-business development	<p>1. Inject cost of production, comparative and competitive advantage, and firm and economy-wide profitability into the national debate on investment priorities</p> <p>2. Improve the investment climate for FDI and reduce the costs of “Doing Business”</p>	<p>3.1. Part of the NATAB annual deliberations would be based on periodic report on “cost of production, international advantage, and profitability” (with annual updates) by the unit in action 1.2</p> <p>3.2 A NATAB committee, in conjunction with RPSF and RIEPA, monitors problems and progress in the “investment climate for agri-business”, small funding for two years to develop pilot approach</p>	<p>No extra cost</p> <p>\$100 (for 3.2 & 3.3)</p>

Problem Area	Needs	Proposed Actions	Indicative Costs (in US \$ '000)
Private Sector Cont'd	<p>3. RPSF (and its 12 "chambers") and RIEPA need to be more involved in priority setting for the NATAB and boards of the ARTT agencies</p> <p>4. More modern agri-business companies capable of exporting a wider range of products to regional and international markets</p> <p>5. Sustainable models for linking small-scale, poor out-growers to private sector businesses capable of organizing higher-value exports</p> <p>6. Need better distribution systems for certified seeds and planting material, veterinary care supplies, animal and aqua-culture feeds, tools and animal-drawn equipment, and selected items for small-scale mechanization (pumps, drip irrigation equipment, walking tractors, etc)</p>	<p>3.3 Design a multi-donor "business incubator" program for the development of viable export business in both traditional and non-traditional agricultural exports. Program would include a risk-reducing Innovation Support Fund (ISF) for matching grants in business start-ups, one-on-one business development advisory services, and dedicated loan guarantees and loan funding for both Rwandan and International-Rwandan partnerships</p> <p>3.4 This will most likely involve building production and training relationships with farmers within a defined radius of a private "nucleus estate" enterprise that would have with production demonstration and pack-house and/or processing facilities and firm opportunities in target export markets. The above "business incubator" program could help fund and develop these pioneering models</p> <p>3.5 Working with the three MINAGRI agencies and cooperating projects, create a share company that will establish a widespread network of retail stores for the distribution and sale of improved agricultural inputs, and selected agricultural equipment</p> <p>3.6 Undertake a bio-technology diagnostic and policy study</p> <p>(See Vol. 2, Annex 6 for examples, similar ideas)</p>	<p>\$200 (for program design only)</p> <p>To come</p> <p>\$200 to collaborate with other donors</p>
4. Insufficient and non-prioritized ARTT system funding, and lack of financial management autonomy	<p>1. ARTT units need to diversify, stabilize, and regularize funding from all sources, to the extent possible</p> <p>2. All ARTT partners need sufficient, stable core funding to assure maintenance of facilities and basic research and technology transfer functions</p>	<p>4.1 Undertake a detailed study to provide an initial detailed response to needs 4.1 and 4.2. It should investigate key topics, such as: (i) How ISAR can make more "results-oriented" budget requests for core and competitive funding; (ii) How more financial autonomy could be achieved, so ISAR can develop "profit centers"; (iii) Are overhead rates sufficient to maintain physical plant and pay some operating costs.</p> <p>4.2: ISAR inventories its physical plant and land base resources to make fuller use of them to: (i) Gain collaborators who can contribute to the applied research program while also producing profits for themselves and ISAR; and (ii) Allow ISAR to maintain long-term control over those resources for future expansion of the scientific research program.</p>	<p>\$100</p> <p>No extra cost</p>

Problem Area	Needs	Proposed Actions	Indicative Costs (in US \$ '000)
Funding and Financial Management -- Continued	<p>3. ISAR needs greater financial management autonomy for improved contract research performance and partial self-financing through involvement in the provision of spin-off commercial agricultural services</p> <p>4. ISAR needs to make use of its land and facilities resources, which are severely under-utilized at some stations</p> <p>5. Incentives to encourage more private sector funding of ARTT</p>	<p>4.3 ISAR separates its potential money-making commercial agricultural services from its scientific work. There are two options for this: (a) keep them within the ISAR structure for reasons of rational facilities sharing and for revenue generation; or (b) spin them off as private sector businesses.</p> <p>4.4: ISAR becomes a partner in “business incubator” program for export agri-business (action 3.3 above). ISAR could be a cost-effective partner by providing low-cost access to potentially available land, buildings, and scientific personnel.</p> <p>4.5: GOR policy makers establish a formula for allocating funds from the National Research Fund for agricultural research and technology transfer.</p> <p>4.6: ARTT system partners create regional ISFs and investment incentives for attracting local (District) administrations and private sector to funding of research and technology transfer.</p>	<p>\$80</p> <p>No extra cost</p> <p>No extra cost</p> <p>\$50</p>
5. ISAR under-performance in key areas	<p>1. Do better job at satisfying its research clientele, especially those who pay for specific products</p> <p>2. Become a “learning organization” where performance in “t” leads to behaviour modification in “t+1” and improved performance</p> <p>3. Become a more nimble, flexible, entrepreneurial organization within some relaxation of GoR financial management rules</p>	<p>5-1: ISAR gets professional technical assistance to develop policies and staff training modules for “client-satisfaction” in its contractual arrangements with partners. This important if it is to play role in new HVH export value-chains.</p> <p>5-2: Once ISAR has adequate core budget (as output of Action 4.1), it will be able to engage in full-cost recovery problem-solving research with a variety of partners and more aggressively market its capabilities.</p> <p>5-3: ISAR becomes leader in advocating for Competitive Funding Mechanisms in Rwanda. To do so, it must itself be competitive in terms of meeting client needs. To do this consultants conduct a critical audit of the contractual research conducted by ISAR and draw lessons learned.</p> <p>5.4: Do a diagnostic study of how ISAR can be given full flexibility to use funds for vacant full-time staff positions to contract private sector research partners and temporary/contract staff and interns to fill skill gaps.</p>	<p>\$100</p> <p>No extra cost</p> <p>\$80</p> <p>\$40</p>
6. Uncoordinated, inequitable, “hit or miss” delivery of improved technology to users	<p>1. Better coordination among MINAGRI, MINALOC, and CSO and donor-funded partners in technology transfer</p> <p>2. Sharing of viable TT techniques and lessons-learned</p>	<p>6.1 In collaboration with the BTC PVD project, and other ARTT efforts, provide support as needed to strategic one-off efforts to promote better system coordination, comparative results evaluations, drawing of lessons learned</p> <p>6.2 Encourage all ARTT units to contribute to the new MINAGRI CICA information databases and the creation and maintenance of its dissemination website</p>	<p>\$200</p>

Problem Area	Needs	Proposed Actions	Indicative Costs (in US \$ '000)
Improving technology transfer -- Continued	3. Basic standards for technology transfer to small, resource-poor farmers and to emerging, somewhat larger-scale, commercial production, processing, and marketing enterprises	6.3 Develop and disseminate standards for “public service” TT services, and those for circumstances where partial and total cost-recovery is justified 6.4 Develop models for CSO and PS agricultural BDS delivery to groups targeted by geo-location, commodity, size of enterprise, ability to pay, category of assistance needed, etc.	BTC PVD BTC PVD
7. Inadequate numbers of appropriately trained staff in key ARTT state and private institutions	1. The ARTT system, in order to produce desired results, needs adequate human resources in terms of numbers, knowledge, skills, and experience 2. Across Rwanda’s main state ARTT units (ISAR, UNR, ISAE, the other MINAGRI agencies) there are desperate personnel shortages 3. One-time infusion of extra funds for selected higher degree training for scientist, technical teachers, and “new age” field program implementers	7.1: Carry out a training needs assessment of the staff of key public and private institutes with important research and training roles in the Rwanda ARTT. This will allow rational planning of comprehensive training, development of instructional methodologies, socio-economic research, etc. 7.2: Increase liaison between training institutions and advisory service providers by establishing “demand committees” through which the training institutions can get ideas for future human resource development. 7.3: Encourage training institutions to conduct more cost-effective “sandwich courses”, in which students spend some time in practical research within research or private sector institutions. 7.4: Adjust the remuneration of academic, scientific and technical staff to improve incentives for results and explore other avenues for motivation of staff, such as performance/achievement awards, paid sabbaticals, etc. 7.6: Develop scholarship, cost-sharing and education loan programs to enable existing and future research scientists, including those in the private sector, to improve their skills.	\$100 No extra cost No extra cost 10 % of annual budget 5 % of annual budget
8. UNR and ISAE training programs for scientists and technicians are inadequate	1. Enhance the competence of UNR and ISAE graduates to better serve the needs of the Rwanda farmers, entrepreneurs and agricultural development “architects” 2. Provide opportunities for lower-level agricultural professionals (A2), farmers and agrobusinesses personnel to participate in “continuing education”	8.1: Support post-graduate training and skills upgrades (sabbaticals, study visits) for ISAE and FACAGRI staff. At least 80% of all should have PhDs. 8.2: Establish/rehabilitate UNR/FACAGRI and ISAE teaching and research laboratories and field facilities to increase practical training opportunities	US\$ 40-75 per PhD US\$ 500 per school

Problem Area	Needs	Proposed Actions	Indicative Costs (in US \$ '000)
UNR, ISEA capacity building	3. Strengthen linkages and partnerships with other institutions at national, regional, and international levels in order to promote cooperation in training, research and out-reach.	8.3: Develop A0 and A1 courses to become more practice-based by attaching students to 'production units' at ISAE/NUR or operated by the private sector (financially supported to also serve as demonstration centers for the industry). 8.4: Encourage ISAE and UNR to continue to develop expanded "continuing education services" to the private sector agri-business community, through short courses, distance ed. and field extension activities.	Funded by value chains \$25/course to develop
9. Efforts to "decentralize" ISAR and ARTT partners and connect them to MINALOC decentralized agricultural staff and farm-level technology users not yet working well	1. ISAR needs to resolve its "three levels" (HQ, Centers, and Stations with personnel and other resources) versus "two levels" (HQ and Stations with personnel and resources) internal organizational debate 2. ISAR needs to figure out how to link to (a) other MINAGRI Agencies, (b) the 450 or so decentralized MINALOC agronomes in the districts and secteurs, (c) the CSOs and projects that are doing TT, and (d) the farmer users of technology, whether defined by geography or commodity value chains or both. 3. The GOR intention to decentralize agricultural planning and service delivery to the district level and below (with central units playing facilitating, ARTT roles) is clear. What is needed now is clearer guidance and field models of how this can and should operate at field level.	9.1: ISAR adopts a more "networked approach" with greater user participation by establishing strong linkages with the MINAGRI and MINILOC technology extension efforts implemented at district and secteur levels by providing the resources for them to play sub-contracting roles with local service providers. 9.3: MINAGRI and MINALOC collaborate to better define models for inter-agency collaboration using the "decentralized" budget for agriculture at district and secteur levels. 9.4: Promote the formation of farmers' groups at local government levels. These groups, in collaboration with other CSO institutions working at those levels, will articulate technology needs. 9.5: Empower local governments, farmer groups and commodity value-chains with resources (funds, infrastructure) to contract with technology generation and transfer providers to solve location/commodity-specific problems and improve the performance of technology transmission.	No extra cost No extra cost Covered by agricultural projects To be within the GoR budget process