AMAREW Final Report

Amhara Microenterprise Development, Agricultural Research, Extension and Watershed Management Project in Ethiopia
July 2002 - December 2007

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The ANRS Partners of AMAREW

Food Security Coordination and Disaster Prevention Office (FSCDPO)
Bureau of Agriculture and Rural Development (BoARD)
Amhara Micro And Small Industries Development Bureau (AMSEIDB)
Amhara Regional Agricultural Research Institute (ARARI)
Environment Protection, Land Administration, and Utilization Authority (EPLAUA)
Amhara Credit and Savings Institution (ACSI)

US Institutional Partners

Virginia Polytechnic Institute and State University (Virginia Tech) - Prime Contractor
Virginia State University
Cornell University
ACDI-VOCA

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Management Entity: Office of International Research, Education, and Development (OIRED), Virginia Tech, 526 Prices Fork Road (0378), Blacksburg, VA 24061 www.oired.vt.edu/

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Cover Photo by Dr. Brhane Gebrekidan
Thanks to AMAREW, this farmer has been able to grow improved barley for seed.

December 2007

AMAREW Project Terminal Report

July 2002 – December 2007

Amhara Micro-enterprise development, Agricultural Research, Extension, and Watershed management (AMAREW) Project

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Executive Summary

The United States Agency for International Development (USAID)/Ethiopia Mission and Virginia Tech signed Contract No. 663-C-00-02-00340-00 in June 2002 to implement the Amhara Micro-enterprise development, Agricultural Research, Extension, and Watershed management (AMAREW) Project to contribute to the overall efforts of the Amhara National Regional State (ANRS) in increasing rural household income, thereby improving food security. The primary objective of AMAREW was to establish community-based paradigm shift within the ANRS for the development of strong and long-term partnerships among collaborating universities, research and service institutions, ANRS bureaus, extension services, and NGOs. The Virginia Tech led consortium composed of Virginia Tech, Cornell University, Virginia State University and ACDI/VOCA, and the primary partners of the consortium in the ANRS, namely Food Security Program Coordination and Disaster Prevention Office (FSPCDPO), Amhara Regional Agricultural Research Institute (ARARI), Bureau of Agriculture and Rural Development (BoARD), and Environment Protection Land Administration and Use Authority (EPLAUA) collaborated in implementing the AMAREW Project from July 2002 to December 2007.

The original Project was designed to cover Agriculture, Natural Resource and Watershed Management in selected woredas of the ANRS, where attempts were made to demonstrate integrative approaches to research, extension, community development, and micro-enterprise development in three targeted watersheds as well as selected pilot woredas. However, the Project was restructured beginning in 2005 to make it more supportive to the New Integrated Strategic Plan (ISP) of USAID/Ethiopia, falling within the Mission's ISP Strategic Objective 16: Market-Led Economic Growth and Resiliency Increased and supporting the ANRS regional food security program through activities concentrated on adaptive, demand-driven food, agriculture and environmental research.

Since its launch in July 2002, AMAREW focused on ensuring good integration of its different components. The functional integration of on-farm research, extension, and watershed management activities addressed by the project have been demonstrated during the life of the project through joint planning and implementation of pre-extension trials and popularization of improved technologies at the project's pilot extension woredas, seed multiplication at the center sites and farmer fields, as well as integrated activities at the three (Yeku, Lenche Dima, and Gumet) pilot watersheds.

AMAREW and ARARI worked collaboratively and have made significant progress in on-farm research activities and identifying technologies for the AMAREW mandate areas.

The ARARI research centers and the woreda level extension offices have done exemplary work in establishing Farmer-Research-Extension-Groups (FREGs), which are active and functional in most of the pilot woredas. Since its beginning, AMAREW has contributed to strengthening research-extension linkage through joint review, planning, and evaluation of research and extension activities executed under the technical as well as financial support of the project.

Community Watershed Management Organizations (CWMO) at the pilot watersheds have currently reached a stage of taking lead roles in the overall watershed rehabilitation work in the ANRS.

In capacity building, in four local universities (Haramaya, Hawasa, Bahir Dar, and Mekelle Universities) 23 diploma holders have been supported by AMAREW to study for their BS degrees, whereas 9 BS degree holders have been supported to earn MS degrees in fields relevant to the development efforts of the ANRS. At the close out of AMAREW, December 2007, 12 students have not yet completed their studies. In addition, about 3414 government staff members have received short-term training in various agricultural technologies.

About 300 research experiments and related activities of different categories have been conducted by the five research centers of ARARI with the support of the project in developing and identifying agricultural technologies that that would enhance food security situations of their mandate woredas. Out of these, a total of 151 technological recommendations were developed primarily for the target groups in the pilot woredas and beyond.

During the 2007 crop season, ARARI and AMAREW made a concerted effort to scale up successful technologies which are envisaged to lay a foundation for strengthening the informal seed sector (until the formal and private seed sector emerges) as an alternative scheme of improved seed source which at present is the major bottleneck of increased production and productivity in the country in general and in the ANRS in particular.

Inadequate availability of certified and improved seeds of most crops including the widely grown cereals and pulses has always been a major bottleneck both in the region and in the country. An alternative approach to backstop the deficit following the scaling up should be to organize farmers who will specialize in production of improved seeds of the various crops so that they will eventually develop into seed producing firms.

In each of the three pilot watersheds of the AMAREW project, community watershed management organization (CWMO) was established during the launch of each watershed program. Each CWMO consists of 12-32 members including women, and are responsible for planning, implementing and monitoring the watershed development activity in their respective pilot watershed sites. To strengthen the capacity of the CWMO, leadership and management trainings were given to all members of the committee, some of the training contents included conflict management, consensus building, community organization and leadership skill and experience sharing tours

In watershed management the most significant component to insure sustainable development is the community participation and empowerment, which AMAREW promoted aggressively. Community participation, as demonstrated by AMAREW, is the process of encouraging the local people to apply their initiative and energy to increase production and develop sustainable integrated watershed activities.

The project put a particular focus on introducing and promoting improved varieties of cereals, pulses, vegetable seeds and fruit seedlings, especially in the dry areas, through revolving seed scheme. The communities have been organized and established committees to control the revolving planting material or seed by establishing community seed bank at watershed level.

AMAREW was initially designed to enable ANRS partners to continue with project activities with full ownership and knowledge of the activities when the project terminates. In fact the owners and implementers of the project activities have all along been the ANRS partners by design. Hence, continuation of Project activities by the owners should follow smoothly when the project phases out by December 31, 2007.

Since its inception, AMAREW has been engaged in supporting on-farm adaptive research as a basis of knowledge-based agricultural transformation primarily in the food insecure woredas. AMAREW took the initiative to scaling up or out of viable technologies which should be continued by BoARD and ARARI.

AMAREW has been working hard to bring about a paradigm shift in the perception as well as practice of the research-extension-farmer linkage in the region. There are some positive and earnest changes in the direction, which should be capitalized on by ARARI, BoARD, and WOARDs.

At the watershed level the Community Watershed Management Organization (CWMO) and kebele leaders can potentially serve as focal points for mobilizing communities for collective and individual development actions, therefore DAs and woreda experts should play a major role in further strengthening CWMOs in all the pilot watersheds.

Efforts to make participatory or joint research-extension-farmer planning, implementation, and monitoring have to be continued at woreda and watershed levels. The WOARD should lead this effort.

Efforts should continue at the woreda and kebele levels for soil and water conservation activities implementation and scaling up following the watershed model. The primary responsibility of this function is that of the BoARD and the concerned WOARD.

Efforts in promoting and expanding micro-enterprise development and income generating activities at the watershed and woreda levels, such as fuel saving stoves, making gabion boxes, honey production with modern bee hives, seed production, small ruminants production etc should be followed up aggressively. The major responsibility of these activities should be that of the WOARDs.

Integration of research, extension, and farmers as practiced by AMAREW in the course of annual work plan development, implementation, monitoring and evaluation will have to be continued by BoARD and WOARDs. The useful lessons learnt from the joint review and planning workshops of the Project should also continue.

The central objective in the initiation of the AMAREW Project was to establish and demonstrate a working strategy for strengthening research extension linkage in selected woredas of the project with the ultimate objective of scaling up such a strategy at the ANRS level. The AMAREW project team paper entitled "Strengthening Research-Extension-Farmer Linkage: The AMAREW Project Experience and Perspectives" summarizes the project's experience.

An internal evaluation of the activities of the AMAREW Project by the RIT was conducted from August 03 to 12, 2006. One of the main conclusions of the evaluation team was that all technological innovations which have been evaluated and approved for meeting farmers' needs should be scaled up and scaled-out. The team recommended that the research and the extension systems should join their efforts and work on scaling-up and scaling out of those technologies.

Background

In response to the USAID Ethiopia Mission RFP No. 663-02-002, Ethiopia's Amhara National Regional State (ANRS) implementation of agricultural research, extension and pilot watershed management and micro-enterprise development activities, the Office of International Research and Development (OIRD) at Virginia Polytechnic Institute and State University or Virginia Tech (VT) and its consortium members presented the ASPIRE (Assisting the Shift in Paradigms in Agricultural Research and Extension) proposal which was selected the winner. The Project Document of the Amhara Micro-enterprise development, Agricultural Research, Extension, and Watershed management (AMAREW) states that its primary objective is to establish community-based paradigm shift within the Amhara National Regional State (ANRS) for the development of strong, long-term partnerships among collaborating universities, research and service institutions, ANRS bureaus, extension services, NGOs, and private sector entities in both the US and Ethiopia. The Virginia Tech Consortium composed of Virginia Tech, Cornell University, Virginia State University and ACDI/VOCA, and the Primary Partners of the Consortium in the ANRS, namely Food Security Program Coordination and Disaster Prevention Office (FSPCDPO), Amhara Regional Agricultural Research Institute (ARARI), Bureau of Agriculture and Rural Development (BoARD), Environment Protection Land Administration and Use Authority (EPLAUA), Amhara Micro and Small Enterprises and Industries Development Bureau (AMSEIDB), and Amhara Credit and Saving Institution (ACSI) have been collaborating in implementing the AMAREW Project.

The Project is generally aimed at assisting the ANRS to design activities, which will result in increased rural household income, thereby increasing food security. To address this overall objective, the United States Agency for International Development (USAID)/Ethiopia and Virginia Tech (as the Prime Contractor) signed Contract No. 663-C-00-02-00340-00 in June 2002 under the Rural Household Production and Productivity increased Strategic Objective (RHPP SO) to implement the AMAREW Project. The Project is generally aimed at assisting the ANRS to design activities, which will result in increased rural household income, thereby increasing food security. The Project advisors are assigned not to plan and implement activities by their own but to advise and assist the implementing institutions of the ANRS in the planning, implementation, and monitoring processes.

The VT consortium team assembled a team of land-grant university scientists and development professionals to assist the ANRS in strengthening its agricultural and natural resource management research, extension, and micro-enterprise development services to foster improved food security and development. Originally the ASPIRE Project, later named the Amhara Micro-enterprise development, Agricultural Research, Extension, and Watershed management (AMAREW) Project, was established to strengthen agricultural research, extension, watershed management capacity, and micro-enterprise development in the thirteen targeted food-insecure woredas of the ANRS by institutionalizing a participatory, community-driven development approach. AMAREW has been inspired by the service-oriented US land-grant university model of integrated extension, research, and education and using the modality of USAID's nine global

Collaborative Research Support Programs (CRSPs), of which VT and Cornell are major contributors.

The original Project document specifies two parts of AMAREW. Part 1 was designed to cover Agriculture, Natural Resource and Watershed Management in selected woredas of the ANRS, where attempts were made to demonstrate integrative approaches to research, extension, community development, and micro-enterprise development in the targeted watersheds as well as the pilot woredas of the Project. The watershed management component was specifically designed to have three major activities: (1) establishment of an Integrated Water Development Management Team (IWDMT) within the BoA (now BoARD), (2) strengthening community-level watershed management through CWMO's, and (3) watershed (micro-catchments) planning and development within the original two pilot watersheds, Yeku in Sekota and Lenche Dima in Guba Lafto.

Part 2 focused on Micro-enterprise Development Activities in the ANRS where the goal was to increase/diversify rural household cash income. The four types of activities envisioned at the start were Microfinance (MF), Micro-Enterprise Development (MED), Demand-Led Entrepreneurship (DLE), and Technology Generation and Promotion (TGP).

2. Staffing

The list of AMAREW Project personnel, along with their positions and service period, is given in Table 1. The list shows that personnel have been hired both from the USA and Ethiopia. The original key personnel of AMAREW were Dr. Brhane Gebrekidan, Chief of Party and Senior Research Advisor (CoP and SRA); Dr. Kent Reid, Watershed Management Advisor (WMA); Ms. Angela Neilan, Extension Advisor (EA); and Mr. Richard Pelrine, Micro-Enterprise Development Advisor (MEDA). At the beginning of the Project AMAREW also hired local counterparts or associates for each of these key personnel as well as a Training Associate. Additionally a complete team of administrative and support staff were also hired. In the Project's life time, beginning of July 2002 to end of December 2007, there have been significant staff turnovers at all categories. Examination of Table1 shows the extent of staff turnover AMAREW has faced. At the close out of AMAREW, the senior staff actively serving the Project was Dr. Brhane Gebrekidan (Chief of Party and Senior Research Advisor), Dr. Nigussie Alemayehu (Research Advisor), Ato Yacob Ashine (Extension Advisor), Ato Getachew Bayafers (Watershed Management Advisor), Ato Semachew Kassahun (Training Advisor and FtF Coordinator), and Ato Ahmed Ayele (Finance and Administration Officer).

In addition to the in-country core staff of the project, others who have been active in the implementation of AMAREW were AMAREW Project Home Office Staff (Table 2), AMAREW Project RIT Members (Table 3), and AMAREW Project Focal Persons (Table 4).

3. Project Start

Project implementation started at the beginning of July 2002. A Kick-off Workshop was conducted on September 19 and 20, 2002 to announce the launching of the Project, and to

introduce the project personnel, partners, and stakeholders to each other. During this workshop the Virginia Tech Consortium and the Primary Partners of the Consortium in the ANRS, namely Food Security Program Coordination Office (FSPCO), Amhara Regional Agricultural Research Institute (ARARI), Bureau of Agriculture (BoA), Amhara Credit and Saving Institution (ACSI), and the Regional Micro and Small Enterprises Development Agency (ReMSEDA, now MSEIDB, Micro and Small Industries Development Bureau) were all present. The proceedings of the workshop were published at the end of 2002.

Table 1. AMAREW Project Staff (July 2002 - December 2007)

S/N	Name	Education	Position	Service Period
1	Dr Brhane Gebrekidan	PhD	Chief of Party and Senior Research Advisor	Jul 2002 - Dec 2007
2	Dr Fekadu Yohannes	PhD	Agricultural Research Associate	Dec 2002 - Jul 2006
3	Dr Nigussie Alemayehu	PhD	Research Advisor	Aug 2006 - Dec 2007
4	Ms Angela Neilan	MS	Extension Advisor	Jul 2002 - Jun 2003
5	Dr Habtemariam Kassa	PhD	Agricultural Extension Associate	Feb 2003 - Feb 2005
6	Ato Yacob Ashine	MS	Extension Advisor	May 2005 - Dec 2007
7	Dr Kent Reid	PhD	Watershed Management Advisor	Jul 2002 - Dec 2004
8	Ato Yitayew Abebe	MS	Watershed Management Associate	Jan 2003 - Nov 2005
9	Ato Getachew Bayfers	MS	Watershed Management Advisor	Jan 2006 - Dec 2007
10	Dr Elias Zerfu	PhD	Res/Ext Training Associate	Mar 2003 - May 2005
11	Dr Eshetu Mulatu	PhD	Training Advisor and FtF Coordinator	Aug 2005 - Dec 2006
12	Mr Richard Pelrine	MBA	Micro-Enterprise Development Advisor	Jul 2002 - Dec 2002
13	Ms Gina Kuta	MBA	Micro-Enterprise Devevelopment Advisor	Mar 2003 - Dec 2003
14	Ato Tenna Shitarek	MS	Micro-Enterprise Development Associate	Mar 2003 - Nov 2003
15	Ato Ali Abdi	BA	MED Officer	Mar 2003 - Apr 2003
16	Ato Abitew Demiss	BA	Accountant	Mar 2003 - Apr 2003
17	Ato Taye Hailu	MS	Program Administrator	Nov 2002 - Jun 2004
18	Ato Andualem Dejenu	BA	Accountant /Assistant Administrator	Feb 2003 - Sep 2003
19	Ato Daniel Nigussie	BA	Accountant /Assistant Administrator	Oct 2003 - Jul 2004
20	Ato Ahmed Ayele	BA	Finance and Administration Officer	Aug 2004 - Dec 2007
21	W/o Saada Mohammed	Diploma	Senior Secretary	Jan 2003 - July 2004
22	W/o Achamyelesh Mengstie	Diploma	Senior Secretary	Jan 2005 - Dec 2007
23	W/o Aster Tekalign	Diploma	Asst Secretary/receptionist	Feb 2003 - Jan 2007
24	W/t Fasika Desta	Diploma	Asst Secretary/receptionist	Feb 2003 - Dec 2007

25	W/t Sefrash Admassie	12th grade	Office Assistant	Mar 2007 - Dec 2007
26	Ato Workineh Yalew	Diploma	Driver	Feb 2003 - Sep 2004
27	Ato Beyene Negash	Diploma	Driver	Jan 2003 - Dec 2005
28	Ato Nebiyu Mussie	Diploma	Driver	Feb 2003 - July 2005
29	Ato Yohannes Bekele	12th grade	Driver	Mar 2003 - Dec 2003
30	Ato Yitayeh Endalew	Diploma	Driver	Sep 2005 - Dec 2007
31	Ato Dereje Bihonegn	Diploma	Driver	Feb 2006 - Dec 2007
32	Ato Yilikal Mekuriaw	12th grade	Driver	Apr 2005 - Dec 2007
33	Ato Mohammed Seid	5th grade	Farmers' Coordinator	Apr 2005 - Dec 2007
34	Ato Dagne Derso	8th grade	Security Guard	Oct 2003 - Sep 2004
35	Major Debebe Tadesse	12th grade	Supervising Security Guard	Sep 2004 - Nov 2006
36	Ato Teshome Mengistu	12th grade	Security Guard	Feb 2004 - Dec 2007
37	Ato Alem Deribe	6th grade	Security Guard	Feb 2003 - Dec 2007
38	Ato Tizazu Belete	3rd grade	Security Guard	Nov 2006 - Dec 2007
39	W/o Yehizbalem Gebeyehu	5th grade	Janitor	Feb 2003 - Dec 2007
40	Ato Tadesse Kassa	-	Gardner	Feb 2003 - Dec 2007

Table 2. AMAREW Project Home Office Staff (July 2002 December 2007)

Dr. S.K. De Datta	Home Office Administrator
Dr. Michael Bertelsen	Long and Short Term Technical Assistance Coordinator
Dr. Keith M. Moore	Home Office Research/Extension Mentor
Hong Zhang	Administrative and Financial Services Associate
Jane Lee	Administrative and Financial Services Associate

Table 3. AMAREW Project RIT Members (July 2002 - December 2007)

S/N	Name	Organization/Responsibility	Service Period
1	Dr. Brhane Gebrekidan	Chief of Party and Senior Research Advisor	July 2002 - Dec. 2007
2	Ato Taye Hailu	AMAREW, Administrator	Dec 2002 - Mar 2004
3	Dr. Belay Demissie	USAID, CTO	Jan 2006 - Dec 2007
4	Dr. Tadele Gebreselassie	USAID, CTO	Sep 2002 – Dec 2005
5	Dr. Abera Tekelmariam	BoRD, Deputy Head	Nov 2002 to Apr 2004
6	Ato Adebabay Mengist	BoA, Extension Head	Nov 2003 – Dec 2004
7	Ato Dereje Biruk	BoA, D/Head	Nov 2002 – Dec 2004
8	Ato Getie Asfaw	BoARD, Planning Dep't Head	Jan 2004 – Jul 2005
9	Ato Mesfin Astatkie	BoARD, Planning/Eval Expt	Feb 2003 – Dec 2005
10	Ato Alemnew Alelign	BoARD, Dep't Head	Oct. 2006-Dec. 2007
11	Dr. Enyew Adgo	ARARI, NR Director	Sep 2002 – Dec 2007
12	Dr. Getie Zeleke	ARARI, Director General	Sep 2002 – Dec 2004
13	Ato Mulugeta Seid	FSPCDPO, Head	Sep 2002 – Dec 2003
14	Ato Tsegaye Boru	FSPCDPO (RIT, Secretary)	Sep 2002 – Dec 2003
15	Ato Amlaku Asres	FSPCDPO, Head	May 2004 - Dec. 2007
16	Ato Assefa Abera	DPPC, D/Head	Jan 2004 – Dec 2004
17	Ato Getaneh Gobeze	ACSI, Planing Dep't Head	Feb 2003 - Oct 2005
18	Ato Mekonnen Yelewumwossen	ACSI, Head	Sep 2002 – Dec 2005
19	Ato Fasika Jiffar	REMESIDA, Head	Sep 2002 – Dec 2003
20	Ato Yared Fekade	AMESIDB, Head	Dec 2003 - Mar 2004
21	Ato Sitotaw Abay	AMSEIDB	Apr 2004 – Apr 2006
22	Ato Yelibe Anley	CPB, Head	Sep 2002 – Dec 2003
23	Ato Ayenew Belay	CPB, Head	Jan 2004 – Mar 2005
24	Dr. Tadess Amsalu	EPLAUA, Head	Oct. 2006 – Dec 2007
25	Dr. Zerfu Hailu	EPLAUA, Deputy Head	Jan 2004 – Dec 2005
26	Ato Getahun Alemneh	EPLAUA	Jan 2006 – Sep 2006
27	Dr. Menberu Alebachew	EPLAUA, Head	Sep 2002 – Dec 2003
28	Ato Amsaya Antneh	BoFED, Deputy Head	Jan 2003 – Dec 2004

Table 4. AMAREW Project Focal Persons (July 2002 - December 2007)

S/N	Name	Organization/RC	Service Period
1	Ato Beruhalem Kassa	ARARI, Gondar RC	
2	Ato Telay Teklewolde	ARARI, Debre Berhan RC	
3	Ato Samson Bekele	ARARI, Sekota RC	
4	Ato Fisseha Worede	ARARI, Sirinka RC	
5	Ato Alemayehu Assefa	ARARI, Adet RC	
6	Dr. Enyew Adgo	ARARI, HQ	
7	Ato Astatkie Kassahun	Sekota WOARD	
8	Ato Desalegn Molla	Gobalafto WOARD	
9	Ato Nega Tibebu	East Belessa WOARD	
10	Ato Biksegn Asfaw	Lay Gayint WOARD	
11	Ato Belew Mekonnen	Sekela WOARD	
12	Ato Tewodros Girma	Tehuledere WOARD	

4. Original Project Objectives

The original main objectives of the AMAREW Project have been:

- Build the analytical, operational and management capacity of institutions within the context of reformed and strengthened research and extension services through the identification of long-term training, short-term training, in-service training, farmer demonstrations and linkages with other institutions.
- Advising and strengthening the Amhara Regional Agricultural Research Institute (ARARI) in implementing its overall institutional agenda;
- Build the capacity of ANRS researchers, research institutions, and research and rural technology development centers to conduct demand-driven applied research on low input, environmentally sustainable technologies that can be applied immediately to food insecure areas.
- Promoting the generation and transfer of appropriate technologies to target communities in the Project's pilot woredas and watersheds;
- Build the capacity of the extension system to disseminate information on environmentally sound agriculture and natural resource management practices, and support other activities that improve the quality of life for rural households in a participatory manner.
- Advising and strengthening the extension services of the pilot woredas in particular and the extension system of the Bureau of Agriculture and Rural Development (BoARD) in general to provide effective extension services;

- Reinforcing the cooperative and collaborative institutional relations between the research and extension services of the BoARD and thereby facilitating and strengthening research/extension linkages;
- Institutionalizing a strong Integrated Watershed Development Management Team (IWDMT) to strengthen project activities in the pilot watershed management areas to serve as model sites for integrating research, extension, and micro-enterprise development efforts;
- Build the capacity of EPLAUA with regard to land use planning, land use policies and programs that involve community level management;
- Strengthen the capacity of existing Micro-finance Institutions (MFIs) and Business Development Services (BDSs) to efficiently provide appropriate and relevant services to rural households and create a measurable impact on the growth and diversification of rural household cash income source through activities concentrating on micro-enterprise development; and
- Contribute generally to the solution of the Food Security Problems of the ANRS through addressing the RHPP SO of USAID Ethiopia.

5. Restructured AMAREW

Based on the directives given by the USAID/Ethiopia Mission, the AMAREW Project was restructured beginning in 2005. The restructuring made the Project more supportive to the New Integrated Strategic Plan (ISP) of USAID/Ethiopia. USAID/Ethiopia support for the Amhara National Regional State (ANRS) Food Security Program falls within the Mission's ISP Strategic Objective 16: Market-Led Economic Growth and Resiliency Increased. Under SO 16, IR 3 (Natural Resource Management and Agricultural Productivity Improved) supports the ANRS regional food security program through activities concentrated on adaptive, demand-driven food, agriculture and environmental research; and a participatory approach to dissemination of technology information, natural resource conservation, and environmental rehabilitation. The AMAREW Project has been addressing SO 16 with a specific focus on IR3. In addressing this overall objective, the Contractor, Virginia Tech, has been working with its active consortium members (Cornell and Virginia State Universities) and its ANRS partners, the Food Security Program Coordination and Disaster Prevention Office (FSPCDPO) as coordinator, the Bureau of Agriculture and Rural Development (BoARD), Amhara Agricultural Research Institute (ARARI), and the Environment Protection Land Administration and Use Authority (EPLAUA).

The following were the major thrust areas of the Restructured AMAREW since the beginning of 2005:

- Building the capacity of the research and the extension system with emphasis on ANRS researchers and extension specialists to concentrate on adaptive research and technology transfer on crops and livestock, soil and water management, environmental rehabilitation and natural resources management, feed and food utilization practices, with the ultimate aim of improving the quality of life for rural households.

- Building the capacity of the BoARD and ARARI with regard to community level watershed management, facilitating and providing technical and operational support for specific research, extension, and community watershed development activities.
- Building operational and management capacity of institutions within the context of reformed and strengthened research and extension services through the identification of long-term training, short-term training, in-service training, farmer demonstrations and linkages with other institutions.
- Contributing to strengthening research-extension-farmer linkage.

5.1 ANRS Partners of AMAREW

With the coordination of the Food Security Coordination and Disaster Prevention Office (FSPCDPO), the additional partners of the restructured AMAREW Project have been the Bureau of Agriculture and Rural Development (BoARD), Amhara Agricultural Research Institute (ARARI), and Environment Protection Land Administration and Use Authority (EPLAUA).

Food Security Program Coordination and Disaster Prevention Office (FSPCDPO): The FSPCDPO is the overall coordinator of the activities of the AMAREW Project including chairmanship of the Regional Implementation Team (RIT), which oversees the activities of the restructured AMAREW. The Project often undertakes additional activities as needed to ensure the effective integration of all USAID-supported programs contributing to the Food Security Program of the ANRS. At the watershed management level, the participation of the Safety Net Project is essential for food resource provision for implementing planned activities.

Bureau of Agriculture and Rural Development (BoARD): Appropriate BoARD departments are expected to support activities in the Agricultural Research / Extension/ Watershed Management Support Program. The BoARD, working in coordination with the FSPCDPO, has the principal technical leadership role for carrying out the USAID-supported extension and integrated watershed management activities in the region.

Amhara Agricultural Research Institute (ARARI): ARARI coordinates research among the principal agricultural research centers, sub-centers, rural technology centers, and the Ethiopian Institute of Agricultural Research (EIAR). ARARI's principal mandate is to ensure that research activities conform with and contribute to the region's food security strategy. AMAREW works directly with ARARI in supporting and technically advising the institute in technology generation and on-farm research, capacity building, and strengthening research-extension linkage. The main centers with which the restructured AMAREW works are Adet, Gondar, Sirinka, Sekota, and Debre Berhan.

Environment Protection Land Administration and Use Authority (EPLAUA): EPLAUA has the ANRS-wide mandate for the overall environment and land related

policies and issues in the region. For the purposes of the AMAREW Project, the relevant activities of the EPLAUA fall under land administration, demarcation, and certification. In particular, the role and participation of the EPLAUA in the pilot watersheds are important. The Project works with EPLAUA in areas of mutual interest.

5.2 Major Components of the Restructured AMAREW

In implementing the project activities, the major components of the Restructured AMAREW were research, extension, watershed management, long- and short-term training, and micro-enterprise development integrated with all components.

Research: Agricultural research activities in the ANRS are directed by Amhara Regional Agricultural Research Institute (ARARI), which coordinates its research program at the national and international level through EIAR. During the year, the major objectives of the research activities were to improve production and productivity through the development and/or introduction of appropriate new technologies. A second but equally important objective was to strengthen human and institutional capacity to sustain the participatory approach to agricultural research and extension.

Extension and Integrated Watershed Management: Two separate, but related, activities were coordinated through the ANRS extension service under IR3. These are: (1) ANRS extension service delivery programs; and (2) integrated watershed management activities in selected watersheds in close cooperation with the Safety Net Program to address natural resource management requirements and build the assets of rural households in the pilot watersheds. AMAREW provided technical assistance, oversight and management support in extension and integrated watershed management. Extension activities were implemented in collaboration with the research and watershed management components. The underlying principle was to build the capacity of BoARD extension personnel to effectively disseminate technology information to rural households using participatory methodologies.

AMAREW continued to use and promote its two established pilot watersheds (Lenche Dima and Yeku) as learning and demonstration centers for integrated and participatory watershed management. Among the lessons demonstrated to visitors of these centers are strategies and methods of community organization for watershed management, approaches and practices in rehabilitation of gullies and reclamation of usable degraded land, integration of research and extension, utilization of technologies for natural resource conservation and enhanced productivity, community participation in planning and implementation of integrated watershed management, establishment and management of area closures, and integration of income generating activities with watershed management practices. Various groups such as farmers, researchers, extension agents, development workers, woreda level authorities, policy makers, and individuals with the overall interest on integrated watershed management visited the learning centers.

Degree Training: Degree training for selected ANRS professionals is a major activity for building human and institutional capacity and facilitating the research/extension paradigm shift. AMAREW has established a partnership relationship with Ethiopian Universities for BS and MS level training. The selection of professionals for training was conducted in a competitive and transparent manner. MS research projects, which form part of the degree requirements, normally take place in the ANRS, with an emphasis on subjects responding to research and extension problems of the region.

Micro-enterprise Development (MED): Although the MED component was not allocated funds through the Restructured AMAREW, the project continued its concerted efforts to establish collaborative links with MED related multi-regional enterprise/market development initiatives funded by USAID and other donors. As a part of the work of the extension and watershed management components, MED related activities such as improved fuel efficient stoves, gabion production, seed production of improved crop varieties, improved fish production and marketing, and horticultural crops production and marketing, were covered by the Restructured Project during the year.

5.3 Focus Areas (Woredas)

In the context of the restructured AMAREW, the RIT took great care in selecting eight pilot woredas for research and extension activities in order to enhance synergy and maximize activity integration in terms of information dissemination, resource availability, and market access. The list of the pilot woredas (by zone) selected by the RIT for initial pilot efforts are given below in Table 5 for each Project component:

Table 5. Selected pilot target woredas by zone and major activity components for the Restructured AMAREW Project, 2006

Target Area	Research	Extension	Watershed
Wag Himra Zone			
Sekota Woreda	X	X	X
North Wollo Zone			
Gubalafto Woreda	X	X	X
South Wollo Zone			
Tehuledere Woreda	X	X	*x*
South Gonder Zone			
Lay Gayint Woreda	X	X	*x*
North Gonder Zone			
E. Belessa Woreda	X	X	*x*
North Showa Zone			
Ankober	X	*x*	
Ensarona Wayu	X	*x*	
West Gojam Zone			
Sekela	*X*	*x*	X

Note*: x indicates reduced level activities*

High Potential Areas: The RIT agreed to include two woredas in North Showa zone, Ankober and Ensarona Wayu, as high potential areas for the active involvement of the project's research component. Ankober is well known for its high potential in potato and barley production while Ensarona Wayu is noted for its outstanding wheat and pulses production. Efforts were made to disseminate research results to end users through the research and extension systems.

At the beginning of the Restructured AMAREW, the RIT also endorsed adding one more watershed with high potential characteristics. The watershed that met this requirement and had been adequately studied and characterized in connection with the original concepts of initiating the AMAREW Project is the Gumet Watershed in Sekela Woreda of West Gojam Zone. This watershed was originally selected and studied as one of the four pilot watersheds for USAID support. AMAREW has scaled up the promising lessons learned in the integrated watershed management of the two pilot sites (Yeku and Lenche Dima) to Gumet and established rapidly watershed management communities patterned after Yeku and Lenche Dima. The Gumet watershed work is making excellent progress.

6. Integration of Project Components

The integration of on-farm research, extension, and watershed management activities addressed by the AMAREW project have been demonstrated during the life of the Project through joint planning and implementation of pre-extension trials and popularization of improved technologies at the Project's pilot extension woredas, seed multiplication at the center sites and farmer fields, as well as integrated activities at the three (Yeku, Lenche Dima, and Gumet) pilot watersheds. The selection of participating farm households, trial sites, and execution of on-farm verification and demonstration in each target woreda have been conducted with the full participation of researchers, woreda extension staff (DAs), and the local farmers. In the Project's pilot woredas, the research and extension components of AMAREW have progressively demonstrated strengthening the integration of their activities both at the planning and the implementation phases. The functional integration of project components has annually involved joint planning and implementing activities by different institutions for the benefit of the rural poor. In brief the three pilot integrated watershed management sites areas are now serving as exemplary sites for integrating research, extension, watershed management, and micro-enterprise development efforts. Similarly, the five pilot extension woredas are serving as pilot woredas for functionally integrating research and extension at woreda levels.

7. Modalities of Implementation

The overall work of AMAREW has been coordinated and overseen by a Regional Implementation Team (RIT), chaired by the Deputy Head of the Bureau of Rural Development (until December 2003) and the Head of the Food Security Program Coordination and Disaster Prevention Office (FSPCDPO) (from January 2004 to date). The RIT has been meeting regularly on a quarterly basis to review and monitor project

progress, review and approve work plans and reports. The RIT members have generally been heads of the AMAREW partner ANRS units (see Table 3 for details).

Concerned institutions of the ANRS, in consultation with technical advisors of AMAREW, normally prepared their plans and reports and submitted them to the RIT. The RIT reviewed and approved plans and reports, before sending them to USAID/Ethiopia Mission. The RIT has also been actively involved in the selection and recruitment of locally hired senior personnel of the project. In general the efforts were made to ensure that the concerned ANRS partners of AMAREW owned the activities and programs of AMAREW.

8. Project-wide Selected Accomplishments

The major trust of the AMAREW project is still to bring about a paradigm shift in participatory methodologies and foster close cooperation and functional integration of research and extension in on-farm activities in the mandate areas with the ultimate aim of improving agricultural productivity and income of farming households. Although a list of selected accomplishments is given below, details of these and more accomplishments are covered in the individual component report presented in this terminal report.

- The ARARI Research Centers and the woreda level Extension offices have done exemplary work in establishing Farmer-Research-Extension-Groups (FREGs), which are active and functional in most of the pilot woredas.
- AMAREW and ARARI continued to work aggressively and have made progress in on-farm research and identifying technologies for the AMAREW mandate areas.
- One hundred five crop, livestock, and natural resources technologies have been disseminated to end users.
- The Small Grants and Mentorship Program (SGMP) became operational in which selected ANRS researchers have established contacts and functional relationships directly with their respective mentors, in USA and Ethiopia.
- Research-Extension Linkage in the ANRS has been enhanced and strengthened through joint planning and implementation of research and extension activities between BoARD and ARARI.
- Successful gully rehabilitation work using sand bag and gabion check dam has been carried out at the Yeku and Lenche Dima watersheds where these sites now serve as learning and demonstration centers for government and non-government institutions.
- Area closure sites with enrichment plantation have been established at the two established pilot watersheds and are under good management by community members, promising good sustainability. The total area closed and treated in the watersheds has reached 586 hectares in Yeku and Lenche Dima.
- The total length of hillside terraces completed by AMAREW measured 1410 km.
- Community Watershed Management Organizations (CWMO) at the pilot watersheds have reached a stage of taking lead role in the overall watershed rehabilitation work.
- In four local universities (Haramaya, Hawasa, Bahir Dar, and Mekelle Universities) 23 diploma holders have been supported by AMAREW to study for

their BS degrees, whereas 9 BS degree holders have been supported to earn MS degrees in fields relevant to the development efforts of the ANRS. At the close out of AMAREW, December 2007, 12 students have not yet completed their studies.

- About 2130 government staff members have been trained in various agricultural technologies. About 80 of ANRS trainees have participated in Project organized short-term in-service training such as training module development, web page designing training, training on training methodologies, and on-farm experimentation training. In up-grading skills of development workers and farmers, over 900 participants have been trained.

9. Selected success stories of the Project are presented below:

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SUCCESS STORY - 01

Fuel-efficient stove production at Yeku watershed

USAID/AMAREW strategy has gender dimensions in which it empowers rural women by organizing them into different self-help income generating groups

Photo: AMAREW Project

Fuel efficient stove produced and marketed by an organized group of women like those in Yeku watersehed, not only helps them make money and contribute to reduction of deforestation, but also reduces the drudgery caused by frequent fuel wood collection from distant locations and encouraged schooling of children. Additional advantage accrued was that the improved stoves reduce smoke caused eye problems, since they contain smoke inside

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Most Ethiopians in rural areas traditionally use wood fire for cooking in the open. The pot or pan is normally centered and placed on three stones. Open fires waste fuel because they focus flames and heat poorly on the bottom of the cooking pot. They are typically only about 15% efficient, which means 85% of the energy that is released from the cooking fuel is wasted. With the use of improved and fuel efficient stoves, it is possible to increase efficiency up to 50%, which can contribute to reduced deforestation significantly. More importantly, improved stoves which burn wood in a closed area reduce smoke in the kitchen and its negative consequences upon the health of women and children.

At the Yeku (Sekota) watershed, ten women as a team were trained by the AMAREW Project on improved stove production in 2004 and at the present moment they have reached a stage of being registered as a cooperative through the cooperative promotion bureau. The project initially provided these women with the necessary stove molds. The women contributed part of their own funds to start the stove production. They started the production of improved stoves with an initial capital of 500 Birr (60 US $). Presently, the women group has raised its capital to over 7,000 Birr (810 US $). This amount was sufficient to provide each member of the stove production and marketing micro-enterprise with a dividend of 500 Birr (60 US $) after saving to the initial capital 2000 Birr (230 US $). Individual annual saving of this amount by women were simply unthinkable cases earlier in areas like Yeku, Sekota.

With the increased efficiency by 50% through the use of improved stoves, it is possible to reduce deforestation rate by 50%, which will ultimately result in vegetation cover increase.

Increased efficiency reduces the household's fuel wood requirement, which indirectly reduces the frequency of wood collection by women and children. This should enable women to be involved in more productive work and leisure time while children will get improved opportunity to attend school. It means, the intervention has an environmental, social and economic positive impact.

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SUCCESS STORY - 02

Gabion Wire Box Production at Lenche Dima Watershed

USAID/AMAREW assists resource constrained farmers to develop micro-enterprises that produce locally unavailable but highly demanded materials to promote local development endeavors

Photo: AMAREW Project

Resource poor rural household heads were trained in gabion box production and provided with a starter capital in kind to engage in an income generating activity like this one in Lenche Dima watershed. The self-help group produces and markets highly demanded but locally unavailable gabions. This activity helped them to supplement their annual income with cash and to make gabions that were procured earlier from places as far as 350 km easily available to the communities at lower cost.

An on-going activity in the area of micro-enterprise development of the AMAREW Project includes gabion wire box production at the Lenche Dima pilot watershed. There is a high demand for gabion boxes in the woreda and its surroundings due to severe gulley formation in various watersheds. The nearest source of gabion boxes for the Lenche Dima area is either Debre Tabor or Addis Ababa with a cost of 350 Birr (40 US $) per box. The same gabion produced by the newly organized self-help group on site costs only 120 Birr (14 US $), which is about a third of what a gabion produced elsewhere costs. The production of gabion boxes at Lenche Dima, in addition to raising incomes of poor farmers' group, will greatly reduce government and non-government institutions' time and money spent through long distance travel for the procurement of gabion boxes.

In view of these facts, the AMAREW Project arranged for the training of selected farmers in gabion production and provided the initial materials for production. Now the gabion production activity in the watershed is functioning in full swing.

Gabion producers at the Lenche Dima watershed are presently contracted by the woreda office of agriculture to produce gabion wire boxes for the various food security programs within the woreda and at zonal level. In economic terms, one gabion-producing farmer within a month can make cash income equivalent to his/her annual income from crop production. To assist farmers to devote all the necessary attention and time to their farming, gabion production is deliberately scheduled during the slack season of January-March.

The entire gulley rehabilitation activity led by AMAREW Project at Lence Dima watershed in partnership with Gubalafto woreda office of agriculture and Sirinka research center uses gabions produced on the site by these producers. This, beyond increasing efficiency of the gulley rehabilitation work, enabled communities to do the work with a lower cost. Using such gabion and other structures, the community in Lenche Dima is successfully rehabilitating a gulley which has once been considered a major threat to farm lands and thereby the livelihoods of farm families.

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SUCCESS STORY - 03

Water Point Development: Top Priority for the Yeku Community

USAID/AMAREW's community empowerment strategy has different dimensions and focuses on addressing the needs of the disadvantaged

Photo: AMAREW Project

For children like Tariku Walelign and friends drinking leech free clean water and going to school is a privilege that comes with the development of a water point in their village.

One of the major problems in AMAREW Project's Yeku and Lenche Dima pilot watershed management intervention sites is the shortage of clean water for humans and livestock. Communities at Yeku have identified water shortage as their primary constraint for the integrated watershed development effort in their watershed.

It is women and children of school age, particularly girls, who should collect drinking water for the family from long distances, whereas boys are responsible to water livestock by collecting leech free water from distant rivers. This burden of collecting water has significantly reduced school enrollment of children.

To solve this water shortage problem, the community at Yeku ranked water point development as top priority. Subsequently, with the support of AMAREW, the community developed water sources including springs and shallow hand-dug wells. Labor and locally available construction materials such as sand, stone, gravel and water were provided by the community while the project provided materials that are not locally available including cement, reinforcing iron rods, pipes, fittings, and skilled labor cost.

The *Bambaw* spring developed in 2005 by the Yeku community is noteworthy. The spring has a spring box with sand filtering system, separate water delivery point for humans and livestock along with a protected washing stand. The spring provides clean potable water for over 200 households and meets the water needs of more than 600 livestock per day.

The *Bambaw* spring is managed and operated by a water committee established by the community where women play a significant role also. Moderate water use fees are collected to cover routine maintenance and costs for guards. The contribution of the newly developed spring in terms of reducing workload for women and children and improving human and livestock health is highly appreciated by the community. Farmers now say, now that we have easy and affordable access to clean and piped water from a spring which is leech free, we can now afford and manage to send our children to school.

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SUCCESS STORY - 04

Ato Dessalew: a Progressive and Early Adopter Farmer

USAID/AMAREW watershed management intervention brought empowerment of watershed communities towards sustainable management of land & water resources

Photo: AMAREW Project

Ato Dessalew, is an innovative farmer, who has protected his farm land with bench terraces, rehabilitated a 6m deep and 4m wide gulley adjacent to his farm and constructed a dome-shaped water harvesting structure and used the collected water to grow diverse crops including fruits like banana, papaya, mango, and several other vegetables, which beyond arresting soil erosion has improved his household income.

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Ato Dessalew is a 35 years old farmer at the Lenche Dima watershed. He is married and has two children. He is one of the early adopters of new technologies that the AMAREW project promotes. His land holding size is about half a hectare converted to a well managed bench terraces with elephant and Vetiver grasses, Sesbania, Pigeon pea planted on bunds for forage production and bund stabilization. He has rehabilitated a gully adjacent to his farm by planting eucalyptus trees. Every year he sells eucalyptus poles from the rehabilitated gully and earns 500 Birr (60 US $).

Dessalew was the first farmer in the community to show interest in the construction of dome-shaped water-harvesting structure. He selected the site for the tank to be at the upper bench of his plot so that he could water his plants using gravity flow. Since the construction of the tank, he has planted more than 20 improved banana seedlings, over 50 fruit trees of mango, avocado, orange, and papaya, as well as vegetables (garlic, peppers, sweet potato, and pumpkin). He has planted adequate forage grass and trees in addition to his eucalyptus wood lot on the rehabilitated gully. His wife is also engaged in growing vegetables such as pepper, onion, and cabbage through supplementary irrigation. Additionally she raises improved chickens. She has been trained in improved stove production and home management.

Ato Dessalew said, “When I began constructing the water tank, I started it half-heartedly. The project took my colleagues and me to visit a tank already in use. During that visit, for the first time in my life, I saw sweet potato, carrot, and beetroot grown in an area smaller than mine. I volunteered right there to complete the well construction and it didn’t take me a week to complete the digging. Now I have every thing in my own compound. My wife is engaged in vegetable production and has created cash income from the sale of these products. We have now started eating vegetables thanks to the training that my wife got through the Project’s support. My cattle are no more taken long distance in search of water after the construction of the tank. I have noted that my neighbors are showing increasing interest on what I do. One of my neighbors has already constructed a water tank similar to mine. This is how farmers learn. Ato Dessalew said, “A farmer wants to see not to hear”.

BEFORE & AFTER - 05

Degraded Gullies Can be Made Productive

Throughout the ANRS, including the AMAREW Project pilot watersheds, deforestation aggravates excess run-off and causes gully erosion on productive farmlands at the foot of hillsides. In our Project area, most farmlands at the foot of degraded hillsides are highly dissected with gully erosion. Increasing amount of extensive productive farmland is lost through gully erosion each year. However, with proper management, gully beds and sides could be converted into productive land for livestock feed, growing construction and fuel wood, and fruit tree production.

Photo: AMAREW Project

BEFORE: The Lenche Dima watershed is a typical example where the devastating effect of gulley erosion could be illustrated. The watershed has a total area of 1500 ha of which cultivated land covers 900 ha. It is estimated that there is about 20 km of gulley network within the cultivated land. Reclaiming these gullies has been taken as a major challenge for the watershed communities.

Photo: AMAREW Project

AFTER: The project used very simple sand bag check dams since the availability of stone for gabion and loose stone check dam is limited. Once adequate silt is accumulated, usually after the first three or four rains, multi purpose forage species were directly sown on the silt layer. The community divided the whole gully length into small sections and allocated each to a user who has land holding adjacent to the gully. The user has the right to utilize the grass employing the cut and carry system and harvesting any other proceeds. He also has the obligation for maintaining the physical structures before and after the rains, plant trees and other plants as appropriate.

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BEFORE & AFTER - 06

Hillside Closure Speeds up Environmental Rehabilitation

Extensive physical and biological conservation works have been carried out in Yeku and Lenche Dima watersheds through food for work as well as free community labor mobilization. The physical conservation works include extensive hillside terracing, check dams using stone/gabion/sand bag, stone and soil bunds, eyebrow and micro-basins, trenches, sediment storage dams, and rock-fill dams. Biological conservation works mainly focused on area closure. Planting Sesbania, Leucenea, and Pigeon pea on bunds on farmlands has been successful. Forage production has enabled farmers to make additional money from the sale of forage seeds to the woreda office of agriculture and NGOs. At the present time over 120 hectares of land is under closed area management in Yeku & Lenche Dima, AMAREW's two pilot watersheds. The closure at Yeku is now serving as an exemplary demonstration site for the Sekota Woreda. Farmers' days are often observed at Yeku to demonstrate the economic and environmental positive impacts of closed area management to farmers, administration representatives, development agents, government officials, and NGOs.

Photo: AMAREW Project

BEFORE: Natural resources degradation is a common problem in the ANRS in general and the AMAREW pilot watersheds are no exception. Water erosion, which is a serious problem in the pilot watersheds, is mainly caused by the heavy run-off from the surrounding degraded hillsides. The pilot watersheds are also seasonally drought prone and afforestation programs have shown very low survival rate of tree seedlings. The fields are almost completely denuded and have little vegetation cover.

Photo: AMAREW Project

Community managed closure area at Yeku

AFTER: The most encouraging and sustainable results we obtained are from natural resources conservation under community owned closed area management system where self-help user groups have been organized to manage degraded hillsides. Under this system, an area to be closed and managed was identified by the entire watershed community with the facilitation role of the Community Watershed Management Organization (CWMO). Farmers have started to observe that natural regeneration in the closure sites has allowed new emerging shrubs & grass species, which were not visible in the past. The extensive physical conservation works constructed by the communities in the closed areas have essentially curtailed the excessive run-off from the surrounding hillsides, resulting in increased infiltration and improved ground water recharge. The Yeku stream flow has now been extended up to four months. User groups get an additional annual income of 400 birr/member by selling grass alone.

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SUCCESS STORY - 07

Rope & Washer Pump Technology: a Supplement to the Water-Harvesting Schemes

In view of combating the persistent food insecurity situation that prevails in large parts of the Amhara Region, USAID/AMAREW supports local initiatives that deliver appropriate technologies for increasing crop production and productivity

Photo: AMAREW Project

In Tehuledere woreda the socio-economics and extension research team of Sirinka Research Center demonstrates the use of the rope and washer pump that delivers water efficiently and at low cost.

The Amhara National Regional State (ANRS) government has been engaged in a massive campaign of construction of water harvesting structures to improve food security and income of smallholder farmers. Farmers have already started growing different fruits and vegetables through small-scale irrigation for their own consumption and the local market. However, if this initiative is not supported with a suitable water management and delivery system, the harvested water may not be accessible to satisfy the crop water demand. Using the hand carried bucket method of lifting water from the storage tank and applying it to plots leads to intensive labor use and excessive wastage of water.

To solve this problem, with AMAREW support, the Sirinka Agricultural Research Center of Amhara Regional Agricultural Research Institute (ARARI) developed the rope and the washer pump which is a promising technology to assist the regional water-harvesting program. The center carried out in Tehuledere woreda demonstration trials of the new pump technology on 21 households owning water harvesting structures and growing fruits and vegetables. More demonstration trials are also planned in other woredas. The growing popularity of this technology can be confirmed through the woreda offices of agriculture and rural development giving lots of purchase orders to local business to produce the pump in massive numbers. The Kalu woreda, for example, has ordered a total of 640 of such pumps for distribution in the woreda.

The rope and washer pump is simple to construct from locally available materials using local skill. It is also easy to operate, saves labor, and helps avoid wastage of water during lifting operations. The major components of the rope and washer pump are a long rope, preferably plastic, with a series of closely spaced circular rubber washers mounted on the rope at their centers. As the rope moves from the water storage tank through the inclined PVC pipe in the structure, each of the washers with about the same diameter as the pipe, takes up a certain quantity of water and discharges it in a trough at the upper end of the PVC pipe. The movement of the rope and washers upward through the pipe and back to the storage tank from outside the pipe is made possible by a grooved wheel cranked with a handle at the center, which in turn is mounted on a wooden frame above the ground.

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SUCCESS STORY - 08

Low-Cost Gravity Drip Irrigation: Assisting Water-Harvesting Schemes

USAID/AMAREW supports development that helps farmers combat low moisture stress in crop production, the primary production and productivity limiting factor making over half of the Amhara Region food insecure

Photo: AMAREW Project

An encouraging result has been obtained from a low-cost gravity drip irrigation experiment carried out in Adet Research Center. This appropriate technology development endeavor assisted by AMAREW has developed a drip irrigation system that overcomes the inhibitory cost factor of such systems. Its use by farmers will facilitate the shift of the production system from its focus on low value grain crops to high value commodity crops such as vegetables and fruits with good market attraction.

Water harvesting schemes implemented in the Amhara Region are intended to contribute to improving the food security and household income of the rural population. Farmers have increasingly come to recognize the benefits from this technology, and the demand for more water harvesting efforts is coming from the rural communities. Due to the limited amount of stored water, the schemes must be supported with appropriate and efficient water application methods in order to realize the anticipated benefits.

Farmers normally apply water to their small plots of fruits and vegetables by manual flooding using hand carried buckets or similar watering containers. This method entails excessive loss of valuable water and may even be insufficient to cover the crop demand for a season. The use of the appropriate irrigation method would help solve some of these problems. One such method is drip irrigation which is recognized for its applicability and water use efficiencies and saving of labor. However, the high initial cost mostly discourages smallholder farmers to invest in the system.

With the initiation and support of AMAREW, researchers at Sekota and Debre Berhan Agricultural Research Centers of ARARI have satisfactorily tested low-cost gravity drip irrigation. A graduate student under the supervision of AMAREW staff has also successfully carried out a field experiment of low-cost gravity drip irrigation using locally available scrap materials and confirmed that it has performance comparable to imported equipment. It is believed that the system components can easily be reproduced by the local people after receiving the necessary training. Farmers can increase their annual crop yield and income several times with the utilization of low cost gravity drip irrigation scheme.

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SUCCESS STORY - 09

Striga Resistant Sorghum Varieties: High Yields Under the Menace

USAID/AMAREW's strategy is supporting endeavors that target issues threatening the attainment of food security in the Amhara Region

Photo: AMAREW Project

Striga hermonthica is one major threat to livelihoods of rural households in lowlands of Wollo as it devastates sorghum fields. With the AMAREW Project support, the Sirinka Research Center is continuously engaged in identifying striga resistant sorghum varieties that meet farms' needs. The endeavor enabled the release of varieties that revived rural households hopes of survival. Varieties such as Gobiye (depicted in the picture) are now widely grown in farmers' fields in Kobo-Girana valley, giving high yields under the threat.

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Striga is a serious parasitic weed in the lowlands of Wollo limiting sorghum production which is the major staple grain crop of lowland-ers. The use of striga resistant cultivars as a component of an inte-grated striga management (ISM) strategy has been found promising Gobiye, Abshir and Birhan are striga resistant sorghum cultivars re-leased by the Sirinka Research Center for striga sick fields of Kobo and Sirinka areas. These improved varieties showed about three-fold yield (25-34 q/ha) in all the sites compared to the local check which due to its susceptibility, may totally be wiped out by the parasitic weed. The increasing use of these new varieties could give additional yields of hundreds of thousands of quintals in the Kobo area alone. The ISM strategy included improved striga resistant cultivar, fertilizer application, and proper crop management practices.

Through a collaborative work between INTSORMIL, the Ethiopian Institute of Agricultural Research (EIAR) and AMAREW about 30 quintals of certified seed of the three striga resistant sorghum varieties were obtained from Purdue University (Prof. Gebissa Ejeta) for fur-ther seed multiplication and distribution in target woredas invaded by this scourge, including the Lenche Dima watershed which is one of the three AMAREW pilot watersheds. This is being done through Sirinka Research Center and the woreda agriculture offices. Thou-sands of farmers participated in an ISM program, doubled and tripled their sorghum yields compared to their fellow villagers who cultivated local sorghum varieties.

The introduction and rapid diffusion of striga resistant varieties is the most feasible option of survival strategy under striga threat in such resource poor rural economies whereby farmers operate under serious limitations of resource and thus could not opt for other control meas-ures.

With the introduction of these striga resistant sorghum varieties, farm-ers have regained the values of their fields that they had lost to the parasitic weed and daily household bread appeared on the family ta-ble, less from food aid and more and more from what is produced the on-farm.

SUCCESS STORY - 10

Farmer-Research-Extension Group (FREG): Strengthening Linkage

USAID/AMAREW's goal is to bring a paradigm shift in the research-extension (R-E) system whereby R-E linkage becomes a reality rather than being a rhetoric

Photo: AMAREW Project

FREG members evaluating the performance of improved faba bean varieties in Lay Gaiynt woreda. Among the varieties obtained from research due to the already functional R-E linkage, the seed of those that are selected by FREG members for meeting farmers' need will be multiplied under a community based participatory seed multiplication scheme for their seed to reach farmers through the local seed supply system under different transaction arrangements.

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Agricultural research and extension in the Amhara Region has attempted to play its role in increasing and stabilizing agricultural productivity. An effective agricultural development, in general, and technology development and delivery system in particular, requires a good linkage mechanism particularly between research, extension and farmers.

The research-extension services, however, have been criticized for two reasons: first, the research problems being investigated are generally not in accordance with the priority needs of farmers; second, the technologies and information generated by the research system have not been effectively transferred to the farmers. The major reason for these problems is the weak or ineffective linkage between research and extension functions.

In order to ensure the participation of stakeholders and strengthen the research-extension linkage, the Adet Research Center with the support of AMAREW Project introduced the concept of Farmer-Research-Extension Group (FREG) in two pilot Kebeles (Gobgob and Yedoro) in Lay Gayint woreda. FREG serves as a mechanism for research-extension linkage in technology development and transfer.

The two FREGs in the pilot Kebeles have been involved in the technology adaptation, demonstration and multiplication of improved crop varieties such as potatoes, faba bean, barley and some others. The FREG members, comprised of 20-25 farmers both male and female and meet at critical times in the season to evaluate, using their own criteria, the performance of the on-farm trials in the presence of both researchers and extension workers. This has enabled the research-extension system obtain feed back on the technologies being demonstrated and allowed projection of the extent of adoption and potential impact of the improved crop varieties in increasing production and productivity in the growing area, which is a primary goal of AMAREW Project. It is believed that the FREGs could also serve in the long run as nucleus for establishing community based seed production cooperatives in the woreda(s) to work towards addressing the unsatisfied improved seed demand of various crops.

SUCCESS STORY - 11

Vernonia: a Promising Industrial Oil Crop

USAID/AMAREW understands the limited opportunity for the rural economy to develop under the dominance of low value cereal-based systems, which do not allow market integration, hence a shift towards high value commodity crops is essential

Photo: AMAREW Project

Market-led rural economy development is highly desired and is the leading agricultural development policy moto in the Amahar Region. This could be achieved if the low value cereal based production system is assisted to include high value crops with market attraction. Such potentials are found in new crops such as Vernonia, an industrial value oil crop receiving research-extension attention in terms of variety development, seed increase, and market search through the support of AMAREW. Intensive tests are being carried out in the region which revealed high yield levels of the crop.

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Vernonia galamensis (a potential industrial oilseed crop) but an indigenous weed in Ethiopia has a potential for export market. As widely documented in the literature, seeds from this plant contain oil rich in epoxy fatty acids and used in plasticizers and additives in flexible polyvinyl chloride (PVC) resins. Additional market potential might be as a drying agent in reformulated oil-based or alkyd-resin paints. Other potential uses for the oil include paint additives, polymers, and plastic additives. In consideration of the potential market in the United States, for example, over 63 million kg of epoxy compounds are used in coatings and adhesives alone annually. In the area of commercialization of the crop, some essential steps have been taken by the Ethiopian Government to attract foreign investors/business firms for commercial production of *Vernonia* oilseed. As an example, a British firm has indicated an interest in purchasing large quantities of *Vernonia* oil.

The Adet Research Center of Amhara Regional Agricultural Research Institute (ARARI) is actively engaged in *Vernonia* research and has released one high yielding *Vernonia* variety (AD7104). The AMAREW Project assists ARARI in strengthening national and international collaboration. For enriching the germplasm base of the crop, AMAREW obtained from Alemaya University 217 germplasm accessions collected from different parts of Ethiopia and delivered them to the ARC for characterization and selection. Currently, ARC is engaged in *Vernonia* agronomic and germplasm evaluation as well as large-scale seed multiplication at its various sites.

AMAREW is facilitating *Vernonia* potential market linkage between US companies and Amhara Region producers through Virginia State University (VSU). One U.S. Company, VSU is linking with is now doing intensive research on the utilization of vernolic acid for various industrial uses. In Ethiopia, there is still the need to intensify research efforts on this crop for both quantity and quality of oil & open up opportunities for the country to exploit the export market. The concern of many of the U.S. companies such as this one with interest on *Vernonia* is the fear of not having a steady supply of V*ernonia* oil year round, which apparently has hindered its large-scale utilization. We believe the issue of sustainable and reliable production and supply of the crop at the required quantities can be handled through diversification in space & time of production. ANRS entities can also manage to increase production through contractual arrangements with local farmers in an out-growers scheme. AMAREW serves as an effective liaison between market in the U.S. and research and production efforts in Ethiopia.

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SUCCESS STORY - 12

Long-term Training Motivates Experienced Staff Stay on the Job

USAID/AMAREW human capacity building strategy encompasses long-term degree training of researchers and development workers to enhance their knowledge and skill to lead a coordinated, visionary and effective research-extension endeavors

Photo: AMAREW Project

These are development workers who earlier had the typical mid-career feeling of stagnation due to lack of self-development opportunities in the remote places they were assigned to work. With the support of AMAREW, 31 such workers are pursuing their higher degree studies as these ones studying in Mekelle University who were visited by a team of AMAREW staff in August, 2005.

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Amhara Micro-enterprise development Agricultural

Frequent staff turnover in search of city jobs or better-paid employment opportunities is one of the developmental bottlenecks in the Amhara National Regional State (ANRS). This is particularly exacerbated within the Bureau of Agriculture and Rural Development (BoARD) and the Amhara Regional Agricultural Research Institute (ARARI), major partners of the Amhara Micro-enterprise, Agricultural Research, Extension and Watershed management (AMAREW) Project. Both ARARI and BoARD naturally place their Research-Extension (R-E) workers in remote and sometimes difficult to access locations. Working for these institutions in remotely situated woredas is becoming increasingly unattractive. Retaining staff in remote areas such as Sekota and East Belessa that have limited or no service provision has been and continues to be difficult.

As a result, none of such remotely situated woredas have anywhere near adequate number of professionals with the necessary education, experience and even motivation to lead a coordinated, visionary and effective research-extension program.

In the absence of any motivating incentive, tolerance levels and empathy for rural life is minimal and experienced staff continually depart from such assignments. With the intention of rectifying the situation and enhancing the competence of development workers, the AMAREW Project has included a long-term degree-training program as part and parcel of its capacity building effort for ARARI and BoARD. In this program, best performing R-E workers with good academic records were encouraged with technical and financial Project assistance to work towards a higher degree. Consequently, the AMAREW Project sponsored 23 BS and 8 MS aspiring development workers recruited from six remotely situated woredas and research centers. The trainees were placed in local universities such as Mekelle and Alemaya.

The hypothesis was correct in that the intervention, beyond serving as an incentive for experienced staff to remain on duty, has improved their ability to do more effective work in their respective areas of responsibility or to prepare them for new assignments. None of the trainees has quit their job. The intention and hope of both ARARI and BoARD is that all the trainees will stay satisfied on the job for extended period of time.

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SUCCESS STORY - 13

Inductive Training for the Novice Research Worker Enhances Competence and Promotes Swift Integration into the Research System

USAID/AMAREW believes that incipient research workers can only be technically empowered if their university education is supplemented by an Inductive Training prior to their commencement of job

Photo: AMAREW Project

For fresh university graduates who decided to pursue their career in Research-Extension like this one it has often been difficult to come on board the research system competently and with confidence without receiving an inductive training because in their initial after school years they still lack competence in a number of areas.

In the best of the cases, newly recruited research staff may have technical knowledge, but often lack experience and confidence to develop and conduct an effective research program. Cognizant of this deficiency, ARARI and AMAREW jointly organized a one-month long module based inductive training in 2005. The trainees were 45 junior agricultural research workers recruited by ARARI and assigned to its seven research centers.

Experienced and knowledgeable resource persons were drawn from the Ethiopian Agricultural Research Organization (EARO), the International Food Policy Research Institute (IFPRI), the Swedish International Development Agency (SIDA), ARARI, and AMAREW to offer training courses on topics under the following thematic areas:

- Problem and opportunity diagnosis and research planning because the incipient researchers must learn to identify significant problems in their respective fields that limit production;
- Ability to work in an interdisciplinary team as this is an aspect of agricultural research that receives little attention during University training;
- Research methods and experimentation in crop, livestock, natural resources, and socio-economics/extension;
- Research proposal and scientific paper writing with emphasis on choosing appropriate experimental designs;
- Overall orientation to the Ethiopian agricultural research system, including Government policy on research, review of research status in specific disciplines, prevailing research gaps, and sources of secondary information.

The program also aimed to create a culture in which all newly recruited staff are inducted into the research system, the research commodity programs they are to join, the requirements of the new job, and the new roles they are expected to play in moving from school to employment.

A post training evaluation done by ARARI and AMAREW showed that the trainees had gained confidence and a better understanding on research problem identification, preparation and evaluation of research proposals, designing and implementation of field experiments. The trainees themselves expressed a high level of satisfaction about the relevance and quality of the training they received.

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Virginia Tech

SUCCESS STORY - 14

Experience Sharing Tours are Useful for Technological Idea Shopping

USAID/AMAREW supports in-country and overseas educational tours as a strategy for technology idea shopping that technically empowers research and extension personnel

Photo: AMAREW Project

Azola, a delicate little weed is a great nitrogen fixer that also stops mosquitos from inhabiting flooded areas. It fixes up to 90 kg N/ha which is an opportunity for emerging rice producing resource poor farm households as they lack readily available cash to buy artificial fertilizer. This is the main reason for the agronomy research team in Adet Research Center to engage in on-farm performance testing as seen on the picture using a specimen brought from India during an AMAREW supported educational tour in 2003.

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Since the start of the AMAREW Project, researchers from ARARI and extension workers from BoARD, local partner institutions of AMAREW Project, have been offered both in county and overseas experience sharing tours financed by the project. This has been done with multiple aims including assessing adaptable technologies and new ideas from elsewhere, seeking mechanisms of successful technology transfer systems, and linking with relevant technology sources for future shopping of technologies and ideas.

Two years ago, a team of 11 researchers in different fields and four professionals from BoARD went to India for a couple of weeks where they visited various research and development institutes in Dehradun, Hyderabad, Bhopal, and Mumbai. The team brought back sketches and specimen for several useful technologies that could be modified and multiplied locally. The crop research team brought specimen of Azola, a bio-fertilizer technology potentially useful in the emerging rice production systems, seeds of horse gram, a high potential crop for drought prone areas, and seeds of various spices and herbs that are high value commodities for the market-led regional economic development. Currently, all these technologies are being tested at advanced stages.

The agricultural mechanization research team also brought back technical drawings and ideas on several farm machinery including single animal drawn plow and harrow, manual row planter and cultivator, hand-held single-ear maize sheller, pedal driven grain thresher, and seed cleaner. The technical drawings have already been converted into technological realities by the Bahir Dar Rural Technology Center, the mechanization research wing of ARARI, which has developed a prototype for each of the tools and machineries mentioned above.

Mr. Assmamaw Endeblhatu, a researcher at the Farm Mechanization Center, who was part of the team, said "If all these technologies were to be purchased from abroad in significant quantities, it would cost the country an exorbitant amount of money, whereas we are able to develop prototypes just by bringing back ideas for a small amount of money spent". Dr. Enyew Adgo, the Natural Resource Research Director of ARARI who was the visiting group leader, has also commented "*the small amount of money spent on sending the team overseas for technology shopping and educational tours was money well spent, because the team returned with minds full of what is to be done next, and that is being seen now*'. This, he said, '*is an innovative support to the regional research system by AMAREW*'.

10. Evaluation of AMAREW

No external evaluation of AMAREW was done any time during the life of the Project. The USAID Mission had repeatedly informed the Project as well as the RIT that external evaluation of the Project will be arranged for and conducted through the Mission's arrangement. However, for unstated reasons such an evaluation was not done.

However, an internal evaluation of the activities of the AMAREW Project by the RIT was conducted from August 03 to 12, 2006. The active members of the RIT representing FSPCDPO, ARARI, BoARD, EPLAUA, USAID, and AMAREW as well as an additional USAID representative and the Project Advisors took part in the evaluation. The RIT evaluation report was printed and submitted to the Mission and also distributed to all stakeholders. Selected recommendations on the way forward identified in the report are presented below.

- Each WOARD has to be able to generate quantitative data that show trends and changes due to the AMAREW Project interventions. It has to be able to show from where to where farmers who received technological inputs supported by the AMAREW Project have reached.
- Each WOARD should encourage improved seed exchange among farmers by seriously following on the revolving seed credit scheme. It can even work towards organizing on-farm seed production and marketing collective action groups, as an alternative approach to strengthen improved seed supply system at the local level.
- The REFAC has to be reinitiated as of 2007 at least in AMAREW Project pilot intervention Woredas using some portion of the AMAREW budget allocated to each WOARD and respective ARARI research center.
- All technological innovations that have been evaluated and approved for meeting farmers' needs should be scaled up and scaled-out. Both the research and the extension systems should join their efforts in the remaining Project time and work on scaling-up and scaling out of those technologies.
- Effective and efficient work has been done in terms of establishing physical water harvesting structures in the Project watersheds. The effort made in promoting the dome-shaped water harvesting structures is yielding encouraging results. Efforts should be further consolidated in the area of water harvesting, as water is one of the major determinants of livelihood systems in the AMAREW watersheds.
- The physical water harvesting structures we observed at Yeku in particular are impressive. With such water harvesting structures in place, it can be concluded that the amount of run-off has already diminished and ground water recharge has increased. The ponds and wells developed thereof should be used for high value vegetable and fruit crops production.
- Joint planning review schedules (Research-Extension to be supported by AMAREW) have to be completed earlier than ARARI's annual review schedule. As recommended for Sekota, AMAREW should be able to conduct its joint planning workshops earlier in September October as of the coming Ethiopian New Year (1999).

- Budget utilization is still poor at the Woreda level. As of August 2006, if the WOARDs have so far not even fully utilized 40% of their annual allocated budget, it means that they will have problems to utilize the remaining 60% of the budget in the short time (one quarter) remaining for the year to come to close.
- All (ARARI, BoARD, AMAREW) should join their efforts towards convincing policy makers to support the linkage institutionalization efforts.
- Much has been done and achieved in terms of on-farm demonstration and validation of improved technologies. A concerted effort should be made to compile data and produce a popular publication in a way that allows technology scaling-up.

11. Paradigm Shift in Research Extension Linkage

The central objective in the initiation of the AMAREW Project was to establish and demonstrate a working strategy for strengthening research extension linkage in selected woredas of the Project with the ultimate objective of scaling up such a strategy at the ANRS level. The Project's team paper entitled "Strengthening Research-Extension-Farmer Linkage: The AMAREW Project Experience and Perspectives" given at the end of this report (pages --- to ---) presents the Project's views.

A supplementary and summarized document "Integrated Agricultural Development Strategies in the ANRS: Lessons from the AMAREW Project" is also attached to this report for futher documentation of the Project's overall efforts in integrated agricultural development of the ANRS (pages --- to ---).

12. Component Reports

Detailed terminal reports for each component of the AMAREW Project are presented below.

Research Component

1. Introduction

The AMAREW project was designed in such a way that five separate and yet integrated components would collectively address the food security problems of selected woredas of the ANRS. These components are micro-enterprise, agricultural research, extension, watershed management, and training. The Research Component (RC) is affiliated to Amhara Regional Agricultural Research Institute (ARARI) and thus has been working in partnership with the research centers under the institute, namely Adet Agricultural Research Center (ADARC), Debre Berhan Agricultural Research Center (DBARC), Gondar Agricultural Research Cente (GARC), Sirinka Agricultural Research Center (SARC), and Sekota Dryland Agriculture Research Center (SDARC).

From the outset, the RC was specifically aimed at generating and demonstrating appropriate agricultural technologies that would support the achievements of the ANRS' regional food security program through activities concentrating on participatory, adaptive, and demand-driven food, agriculture and environmental research. Playing a pivotal role in bringing about a shift in the existing traditional top-down approaches of research and extension paradigm was also taken as one of the objectives of the RC since it is essential for the success of the program as well as for the desired sustainable development and food security thereof. While empowering professionals at all levels to get hold of innovative approaches, and households and communities to take the responsibilities of resolving their problems by making informed choices in planning and implementation of agricultural and natural resources management technologies was another area of focus for the component.

In addition to promoting activities consistent with the objectives, the RC was actively supporting the overall efforts of the project designed to address such critical social concerns and crosscutting themes as addressing nutritional problems and access to food and balanced diet, issues related to household income and diversification of agricultural production. Capacity building for agricultural personnel in essential disciplines related to adaptive agricultural research, extension, natural resources management and micro-enterprise development and also skill building for individual members of households or groups from the community so that they will be able to use these skills and become more resilient communities has been an integral part of the projects' endeavors and also of the RC.

Since AMAREW Project's beginning in the second half of 2002, the agricultural research component has been operating as an integral part of the project in its efforts to deliver the far-reaching objectives stipulated from the outset. During the final year of the project the RC conducted an assessment of the achievements of the component. In conducting the assessment, all relevant information from the research activities implemented by each partner center, the results obtained and the status of these results including whether the technologies have been utilized by the farming community were considered. In order to accomplish this task, various compilation formats have been developed and used.

Although the major synthesis work was done at AMAREW-level, much of the basic information was collected and compiled by the research personnel of the partner centers. This report presents excerpts of the major achievements of each center in agricultural technologies for increased production and productivity of natural resources (forestry, agroforestry, soil and water conservation, area closure, water harvesting, irrigation systems, and water lifting techniques), livestock (small ruminants, poultry, apiary and forage crops) and crop varieties and production packages of cereals, pulses, oilseeds, vegetables, and fiber crops. Furthermore, this terminal report gives emphasis also to the major accomplishments of the RC in bringing about a shift in thought and practice, among various stakeholder institutions and individual actors, to realize that a strong and harmonized research-extension and farmer linkage would play a pivotal role in the development pathway. The efforts made to empower the community by creating and strengthening nucleus groups of informal seed producers so that they can ultimately develop into bigger and improved seed producing firms are also discussed. The report also covers accomplishments made in the Small Grants and Mentorship Program (SGMP) of the project in addition to a summary of accomplishments accrued through the program of Short-term Technical Assistace (STTA).

2. Objectives and scope of the assessment of the RC

The RC made an internal assessment of its work critically analyzing the available information and methods followed by the stakeholders in the process of planning, implementation, dissemination, and utilization of technological results. Specific objectives of the assessment work were:

- To properly document the research activities undertaken and results obtained and disseminated over the last five years,
- To assess whether or not the research component of the project has really met the fundamental objectives set at the beginning of the project, and
- To draw lessons that would be of use to scale up positive and sustainable outcomes of the research outside the target groups but with similar circumstances, and also establish methodological norms for implementing agricultural research in a way that it will be an integral part of the development services.

3. Methodologies and modalities of assessment and consolidation of information

Review of past project documents and periodical research reports at AMAREW office as well as research centers was the primary means used to collect, consolidate, analyze and compile the required information. Among such vital documents were signed agreements between AMAREW stakeholders, AMAREW Kickoff Workshop proceedings, baseline survey reports of ARARI centers and the ANRS government, planning reports, quarterly and annual reports, progress reports, other documents such as success stories prepared by AMAREW, RIT evaluation report, proceedings, and others. The actual record of these materials is given under the list of references at the end of this section of this terminal report. To obtain reliable data, a structured format for gathering information on the

various sectors of crops, livestock, natural resources, socio-economics, and research and extension endeavors made by the different partner research centers under the financial support of the project was drafted by the Technical Advisors of AMAREW. This draft format was thoroughly discussed with the directors, project focal persons and researchers at each center in order to enrich and refine it further and make it more relevant to the respective center.

The format was developed in a way that it will address, for each sector, such important benchmark issues as the overall picture of the farming systems in terms of production and productivity of the major crop and livestock commodities of the area, the natural resources supporting socio-economic features, the extension services delivered to the community, market and off-farm employment and other additional income generation opportunities and the major biophysical factors constraining production and productivity at household levels. Furthermore, by way of consolidating the research activities and outputs thereof, the format was prepared to accommodate, among others, such detailed items as the list of experiments conducted under each sector, the locations where these experiments were conducted, the major finding(s) secured, and the subsequent measures taken to bring these findings into large scale use by the target groups. Information was gathered, as much as possible, to establish the overall performance and merit of the interventions as compared to the traditional way of production.

Based on the format distributed and discussed with the ARARI centers, feedback was obtained and thus the first draft document of the consolidation was prepared by the research advisor (RA). The initial draft document prepared at AMAREW level was distributed to the centers upon which the AMAREW Technical Advisors held thorough discussions with the respective center directors, project focal persons and relevant researchers on the particulars of the document. Therefore, the compilation of information was made at two levels, a) at AMAREW level entirely based on the planning and progress reports and b) at center levels. Differences encountered between the two sources were cleared up through continuous interactions with the centers. Finally the document was further enriched and prepared at AMAREW office which was again given back to each center to get its approval and make sure that the contents of the document really represent the facts actually experienced by the centers. With further incorporation of their comments, the RA finally prepared the synthesis of this final form of the consolidation document on the research component of AMAREW.

4. Synthesis of assessment results

Based on the feedback obtained from the partner centers as well as other information from different secondary sources, syntheses of description of the farming systems in the target woredas, technological recommendations as well as other interventions made to leverage production and productivities of the various agricultural sectors are discussed hereunder.

4.1 Overview of the farming systems of the target woredas and the major constraints of production and productivity

As has been stated earlier, AMAREW has been operating primarily in the most food insecure woredas of ANRS in Wag Himra, North and South Wollo, North and South Gondar, and two woredas from North Shewa representing agriculturally high potential areas. Each zone was again represented by one woreda and thus respectively Sekota, Gubalafto, Tehuledere, East Belessa, and Lay Gayint represent the food insecure woredas, while Ensarona Wayu (now Seya Debrina Wayu) and Ankober represent the two high potential woredas of North Shewa. Although these are the partner woredas that have been involved throughout the life of the project, a number of other food insecure woredas were embraced by the project during the first year of operation. The research component of the project has been closely working with the respective research centers of ARARI that are catering for each woreda in order to address their technological problems. A brief account of the farming systems in general and major production constraints relevant to agricultural research in the pilot woredas are presented next.

The majority of the target woredas, as has been said time and again, is drought-prone, highly degraded, mid-to-high altitudes characterized by critical shortage of food and feed for most of the year. Except few (those in North Shewa and Tehuledere), the others had little or no access to improved technologies of natural resources management, livestock, or crops. On the other hand, the menace of diseases, insect pests and weeds are so sever that complete losses of crops are common incidences. Therefore, areas like Lay Gayint, Sekota, and East Belessa are always under food handout programs. Even in those potentially better areas of North Shewa, the diversity of crop options for the farmer are limited because of either extensive vertisols of the plains or frost hazards as in the case of Ankober. Furthermore, the physical distances of the sites from bigger towns and cities have limited market access opportunities. It is, therefore, with such a background that the research component of the project launched its operations to make positive differences by providing appropriate agricultural technologies in a truly participatory manner. Some self explanatory pictures depicting some of the challenges at the various areas of the Project are illustrated below.

Fig.1 *The menace from the invasive weed Parthenium (left) in Wollo and the parasite Striga (right) in most of Eastern Amhara is much beyond the level of tolerance and thus among the so many research problems that the research centers are grappling with those associated with parasitic, invasive and noxious weeds take a significant share.*

Fig.2 *Developing technological options suitable for such very mountainous and cold environments of frost prevalence as in Ankober where barley and faba bean are the only traditional crops, is an eminent challenge for DBARC. The weather in early November (when crops are supposed to be mature and ready for harvest) is still rainy and extremely murky.*

Fig.3 *Extreme cases of vertic properties of the soils in the plains of Enewari also present challenges to diversify the crop production options. They become too much waterlogged for most crops during the rainy season or dry up and crack heavily damaging the roots of crops grown on reserve moisture like the chickpea seen in the photo. Under waterlogged conditions the incidences and severity of diseases for crops like faba bean are high posing another challenge of developing resistant varieties.*

Fig.4 *Glimpse of the challenges that one faces in trying to curb food insecurity through agricultural research and development in Sekota. The problems are so intricate and thus it takes a lot of effort and courage to come up with best bet solutions.*

4.2 Technological interventions developed

The research component of AMAREW has been supporting ARARI over the last five years in its effort to provide technological options for the farming community in the target woredas by conducting participatory on-farm adaptive research on natural resources management, crop and livestock production and productivity, socio-economics and research and extension facets of its mandate. This section is, therefore, intended to present the synthesis of the compilations of specific research activities undertaken by the different partner centers, major findings or results obtained in each sector and transferred to the target groups since the beginning of project implementation.

However, before going into the sector-wise discussions of research activities and achievements, it is imperative that some explanations be given as to which centers and locations were involved during the implementation of these activities. At the beginning of the project in 2003, four centers of ARARI, namely Adet, Sirinka, Sekota and the then Sheno (now Debre Berhan) Research Centers planned and conducted a total of 128 adaptive research activities (Table 6) in 13 woredas and at 56 testing sites. Adet addressed three woredas (Lay Gaint, Simada and East Belessa) with 13 testing sites; Sirinka addressed four woredas (Kobo Zuria, Tehuledere, Delanta, and Tenta) with 27 testing sites; Sekota addressed only Sekota woreda with six sites; and Sheno addressed four woredas (Efratana Gidim, Kewet, Gera Keya and Lalomama) with 10 testing sites. A total of 51 on-farm trials were conducted by ADARC, 40 by DBARC, 33 by SARC and 12 by SDARC during the year.

In 2004 a decision was made by AMAREW and its ANRS partners that too many woredas and sites were addressed the previous year and thus focus would be given to only one woreda per Administrative Zone of the project. Accordingly, Adet Research Center handled South and North Gondar Zones through Lay Gayint and East Belessa woredas, respectively. Similarly Sirinka was responsible for South and North Wollo Zones, through Tehuledere and Guba Lafto; while Sekota worked in Wag Himra Zone through Sekota woreda; and Debre Berhan handled North Shewa Zone through Gera Keya woreda. It was also decided during this year that all the components of the project namely, Research, Extension, Watershed management and Micro-enterprise development components have been working in a concerted and integrated manner in two selected pilot-watersheds (Yeku in Sekota and Lenche Dima in Guba Lafto) in addition to the extension sites outside the pilot watersheds. During this year, 85 on-farm experiments were conducted in the different woredas and sites, of which ADARC conducted 21, DBARC 10, SARC 33 and SDARC 21 experiments including those which were continued from the previous year (Table 6).

In 2005, with the restructuring of AMAREW, it has been decided that the research component would also focus on two high-potential (food-secure) woredas in North Shewa. Therefore, DBARC took Ankober and Ensarona Wayu woredas as project areas in North Shewa Zone. The other woredas in the zone, which were covered by

the center in the previous years, were decided to continue for only one more year so that research activities started earlier could be completed. During this year, ADARC conducted 20, DBARC 10, SARC 37 and SDARC 34 experiments that added to 101 AMAREW-supported on-farm experiments (Table 6). At each center, the number of the experiments constituted both newly proposed ones and carryovers from the previous two years.

In 2006 East Belessa was handed over by ADARC to the newly established Gondar Agricultural Research Center (GARC) along with all the then on-going activities of the project at the site. Consequently, of 105 new and on-going experiments financed by the project for the year, ADARC handled 7, DBARC 14, GARC 24, SARC 44 and SDARC 16 (Table 6).

In 2007, since it was the final year of operation for the project, emphasis was given by all stakeholders at each center, that the focus should be on technology scaling up/out. Hence appropriate technologies were jointly identified and approved for the scaling up at each woreda. This being the general picture of the technology development part, the next section gives brief descriptions of the sector-wise activities undertaken and achievements obtained under each.

4.3 Achievements in natural resources management research

As stated above, a general inspection of the data over the years (Table 6) indicates that since the beginning of the project, more than 460 on-farm experiments (counts after 2003 include carryovers from previous years) were conducted by the different partner centers of ARARI with the financial and technical support of AMAREW. Of this number of experiments, some 13% (61 in number) were experiments related to natural resources (NR), conducted by all the five centers. However, the number of experiments across the centers varied in that SARC (20) and SDARC (19) together accounted for about two thirds of the total number of experiments on NRs, while the remaining third was distribute among the other three centers (DBARC =9, GARC=10 and ADARC=3). The experiments registered under NRs in all the partner centers included those related to soil, water, forestry, agro-forestry, and ecological rehabilitations through area closures. A more refined scrutiny of the data reveals that four areas of research were of major emphasis, namely adaptation, demonstration, and verification studies and survey works (Table 7). It is also discernible from Table 7 that the number of research activities corresponding to each of these categories was 24, 7, 3 and 6 which sum up to a total of 40. Of these 40 research activities related to natural resources management and conducted under the support of the project, 15 were undertaken by SARC, 10 by SDARC, 7 by GARC, 5 by DBARC and the remaining 3 activities by ADARC. The major findings, which came out of these at each center, are discussed next with corroborations from Table 8.

ADARC: During the early times of AMAREW, Adet Research Center, with the support from the project, conducted investigations on the rates of closed area regeneration with and without employing complementary water harvesting techniques at Lay Gayint. It was found out that closure immediately after burning without water harvesting and enrichment planting showed a better potential to encourage the regeneration of different species of trees, shrubs, grasses and herbs. This was assumed to be due to breakdown of dormancy of seeds of the species by the heat. Closure with water harvesting but without enrichment and closure without water harvesting but with enrichment showed a comparative economic advantage in biomass production. *Tungit*, *Embuacho* (*Rumex nervosus*) and *Kitkita* were the most dominant among the tree, shrub or herb species while *Gaja* (*Andropogon spp*), *Serdo* (C*ynodon dactilone Digitaria scalarum*) and *Senbelet* (*Hyperrhenia rufa*) were dominant among the grass species in the closed area. In general, area closure was found to be a quick and cost effective method to rehabilitate marginal and unproductive land in Lay Gayint. It also provides farmers with the economic opportunity of selling grass for animal feed and/or material for roof thatching. The integration of such water harvesting techniques as trenches for collecting runoff with area closure was proved effective against soil erosion as well.

Evaluations of different water harvesting techniques of eyebrow, micro-basin and trench in improving the survival rate of tree seedlings (*Acacia saligna, Crotone macrostachyus,* and *Cordia africana*) were made in Simada Woreda. Generally, the plots with different water harvesting techniques gave satisfactory results compared to those plots on which no such techniques were employed. The survival rates of *A. saligna* were found to be 91% for eyebrow, 78% for micro-basin, and 62% for trench as compared to 28% on the plots without water harvesting technique. *C. macrostachyus* performed well in the trenches with a survival rate of 48% on micro-basin. On the other hand, *C. africana* did not show a significant increase in the survival rate; only 11%, 2% and 2% on trench, micro-basin and eyebrow, respectively. It was, therefore, concluded and recommended that water harvesting is the best option for the growth and increasing the survival rate of tree seedlings in drought affected and moisture deficit areas such as Simada Woreda.

DBARC: The center has established the merits of closing degraded areas whereby different techniques of water harvesting and enrichment plantations were incorporated. Such treatments as closed area without water harvesting and enrichment planting; closed area with enrichment planting using the local *Acacia*, "*Kesele";* closed area with water harvesting and enrichment planting, and farmers' practice of burning for natural regeneration with neither water harvesting nor enrichment planting were investigated at different sites. The advantages accrued from the closed area were so eminent that the farming communities in the surrounding have spontaneously adopted the practice of area closure.

Fig. 5 *Area closure, as was found by many other centers, was also found by DBARC to be an effective method for rehabilitating highly degraded mountain hills in a relatively shorter time span even without any supplementation with plantings. The natural vegetation turns back very soon from the soil seed bank as could be seen here from the photo that has been taken at Shewa Robit in North Shewa.*

Evaluation of different water harvesting techniques such as eyebrow, half moon, and collection trench, which were intended for improving the survival rates of tree seedlings at Mehal Meda (Gera Keya) and Shewa Robit woredas have resulted in differential responses in survival rates as well as growth performances of different tree species. Based on these results, the collection trench and half-moon or micro-basin water harvesting techniques were recommended for such moisture-stressed and degraded hills of the lowlands in Shoa Robit while eyebrow was recommended for Mehal Meda. Furthermore, *Acacia nilotica* was found best adaptable for Showa Robit while *A. albida* was adaptable for Mehal Meda.

The Amhara Regional Government, in pursuant to achieving food security and improving the income of the rural households, is heavily engaged in water harvesting, introduction of high-value crops such as fruits and vegetables, linking the farmer with both domestic and external markets, and the like. Traditionally, however, farmers apply what so ever amount collected water to their fruit and vegetable crops by simply flooding their plots or by using buckets and other similar water containers. The traditional method of watering crops will inevitably lead to excessive loss of the water, which is very often scarce and not sufficient to cover the crops' demands during the season not to mention the sequel of drudgery involved in fetching the water. Investigations were, therefore, conducted by the center to develop complementary techniques of sound water use efficiency. To this end, the center with the support of AMAREW took the initiative for testing the technology of low-cost gravity drip irrigation for the production of vegetables such as onion, tomato and others. The results revealed that drip irrigation gave much better yields while at the same time minimizing water and labor wastages compared

to traditional irrigation methods. Drip irrigation also resulted in higher marginal rate of return. Farmers have recognized the benefits from this technology, and the demand from the rural communities for the technology is becoming tremendous.

Fig. 6 *The low-cost gravity drip irrigation system tested and recommended by the partner research centers of ARARI with the support of AMAREW.*

SARC: The center, with the support of AMAREW, has given major emphasis in availing technologies, for the farming communities in its mandate areas, pertaining to three principal areas of research on natural resources management. These are: technologies important for fast rehabilitation of degraded ecologies, enhancing forestry and agroforestry, and effective and efficient utilization of scarce water resources. Accordingly the following research outcomes were realized:

The merits of different kinds of check dams, grasses and shrub species evaluated for gully stabilization were well established for highly degraded watersheds such as the Lenche Dima Watershed. The best alternatives for rehabilitating degraded hill areas in a relatively shorter time span using the different conservation techniques were also identified. The area rehabilitated in Lenche Dima is now being widely used as a model of Field School for training farmers from other areas of similar needs even outside ANRS.

The Natural Resources Division of SARC was able to conduct a long-term evaluation of different *Acacia* tree species in a small arboretum on the center with the support of the project. The types of *Acacia* trees observed include: *A. polycantha* (magic tree), *A. salcina*, *A. nilotica*, and *A. hockii*. The performances and adaptability of these species were well analyzed and documented by the center. Besides the center is now using this plantation as a source of seed material for dissemination.

In an effort to introduce different agro-forestry tree species to local farmers, SARC has established a small tree nursery at Harmot River (3 km before Kobo town),

which is serving now as a source of tree seedlings for the surrounding and beyond. The agro-forestry tree species are *Gravellia robusta*, *Acacia polycantha*, *A. senegal*, *Azadericta indica*, *Shinus molle*, *Casuarina equistifolia*, *Morus alba* (*Injori*), and *Eucalyptus* spp.

The ANRS Regional Government has been engaged in a massive campaign of construction of water harvesting structures in order to improve food security and income of the smallholder farmers. Farmers on this line have also started growing different fruit and vegetable crops for consumption and local markets. In order to support the effort with suitable water management practices, since the harvested water may not be sufficient to meet the crops' demands for water, SARC has developed a new water lifting technology called *Rope and Washer Pump* as an alternative to the traditional bucket and carry method of lifting water from a storage and its application to plots which is severely cumbersome for it leads to excessive wastage of water and labor. The rope and washer pump can simply be constructed from locally available materials and using local skill. It is easy to operate, saves labor and helps avoid wastage of water during lifting.

Fig.7 *Demonstration of the Rope and Washer Pump in Tehuledere Woreda by the focal person of AMAREW from SARC*

The rope and washer pump was found to be a promising technology to assist the regional water-harvesting program by different woredas and thus the center carried out extensive demonstration trials in different woredas including the AMAREW's pilot woredas, Tehuledere where farmers have water-harvesting structures and are growing fruits and vegetables. It was also confirmed that other woreda offices of agriculture and rural development and also local businessmen were inspired to multiply the technology in large quantities.

SDARC: Adaptations of tree and forage species such as *Olea africana, Erythrina brucei, Acacia saligna,* Lablab, vetch, pigeon pea, cowpea, and Rhodes grass were made by the center to reinforce the efforts of the farmers, DAs and development experts in the woreda geared toward assisting ecological recovery in the area. The tree and forage species introduced can effectively supplement the natural vegetation which otherwise would be the sole source of browse for goats which in turn constitute the predominant proportion of the livestock population in the region.

On-farm verification of physical and biological soil conservation measures for gully stabilization and biomass production confirmed that these technologies can readily be used for the dryland conditions of Sekota and thus the technologies have been handed over to the WOARD for their wide scale extension.

Extensive studies were made on indigenous trees and shrubs around churches, and monasteries in Sekota Woreda and commendable recommendations on the current forest status and also strategies for sustainable use and maintenance of such a flora have been synthesized based on the qualitative and quantitative information obtained from the studies. These recommendations are prepared in a form to be used by church leaders, DAs and experts of WOARD. The outcomes of the studies were also found important inputs to embark on further research activities, which are presently undergoing. Based on the outcomes of the survey, the following, among others, conclusions were drawn:

1. In almost all the surveyed areas, the trees are old and are virtually dying. Therefore, such silvicultural measures as enrichment planting and thinning are urgently needed.
2. Genetic conservation and management of the seed bank from the soil are essential measures to be taken to rescue the severely dwindling gene pool and also enhance the viability of the seeds of indigenous species.
3. Strong collaborations between different administrative and funding agencies with the church officials are urged to enhance maintenance, expansion and utilization of forest.
4. Advocacies have to be made on the aesthetic as well as economic values of forest and along therewith ensure the rights of individuals who plant and manage trees have to be ensured.
5. Alternative activities and practices that will discourage or substitute the needs for wood or any other requirements that entail or encourage forest depletion must be expanded.

Based on the experiences of other partner research centers, SDARC also launched studies on the use of the small-scale gravity drip irrigation system to test its appropriateness in Sekota Woreda in a bid to develop a sound water utilization system for the water harvesting scheme intensively worked on by the WOARD. The system is found appropriate for the area in addition to the advantage that it can be produced from locally available material and skill.

4.4 Achievements in crop production research

It is discernible from Table 5 that the great majority of the on-farm experiments conducted by each center every year constitutes crop research representing some 74% of the 463 experiments conducted over the five-year period of the project. Of 104 on-farm experiments conducted by Adet Research Center for example, with the financial as well as technical support of AMAREW during the last five years, crops accounted for 97. Similarly at DBARC crops research accounted for 68 of the 85 on-farm experiments supported by the project. Sixteen of 34 at GARC, 110 of 147 at SARC and 53 of 91 experiments at SDARC were on crops.

Perusal of Table 6 also reveals that most of the activities on crop research were adaptive and demonstrative in nature. The two categories correspondingly represented 24 and 37 experiments at ADARC, 14 and 15 at DBARC, 2 and 1 at GARC, 27 each at SARC and 17 and 6 at SDARC. The Table also shows that almost all activities principally ordained to empower the community; including such activities as establishment of FREGs, and organization of communities for informal multiplication of technologies, mainly improved seeds, were related to crop production. Unlike the rest of the centers, however, DBARC has conducted relatively a large number of verifications (10 out of 49) on crop technologies while ADARC and SARC had one verification trial each and GARC had none thus far. Except at DBARC and SARC, nowhere was conducted any activity pertaining to the marketing of crops or crop-related products. To the satisfaction of the project as well as every stakeholder involved, 2007 was considered as the season of scaling up of crop technologies, which have been found successful during the project's lifetime. More will be said of this later but before going into discussing the scaling up activities, some detailed discussions on crop types and associated results secured over the last five years seem pertinent for which Tables 8-10 are given for corroboration.

In general cereals, pulses, oil crops, fiber crops, and vegetable crops were all investigated by the partner centers under the financial as well as technical support of AMAREW (Tables 8-10). As could be seen from the Tables, a total of 71 improved varieties of cereals have been recommended by the centers after evaluating their adaptability to their respective locations. This, however, does not imply that the varieties of the same crop are altogether different from center to center. As the case in point, for example, same sorghum varieties have been recommended by almost all the centers dealing with the crop and this holds true for

the other crops as well. In the same way 25 improved varieties along therewith their production packages of pulses, oil crops, fiber crops and vegetable crop technologies were recommended after being scrupulously tested by the respective centers. The center-wise details on the crop varieties developed by each center are given below.

ADARC: The center has developed 16 recommendations on improved varieties and production packages of cereals, 5 on pulses, 3 on oil crops, and 3 on potato. All the major cereals except sorghum were extensively dealt by the center. Among the pulses, however, varieties were developed for faba bean and chickpea. Likewise, while improved varieties of linseed represent the league of oil crops developed for the project woredas catered by Adet, potato constitutes that of vegetables. The varieties developed include: *Shina, Taye, Senkegna, Galema, Kubsa, HAR-2536, HAR-2029, HAR-1775 and Et-13* for the bread wheat varieties; *Mulu, Shedeho*, and *Setegn* for food barley; and *Sinan* and *Minet* for triticale. The five varieties of pulses also include: *Degaga, CS-20DK, Adet Hana* and *Mesay* for faba bean and *Marye* for chickpea. The linseed varieties *Geregera, CI-1525* and *Berene* were among the oilseeds recommended by the center for the pilot areas while the recommended potato varieties included: *Zengena, Guasa* and *Tolcha*.

DBARC: The center with the support of AMAREW conducted extensive on-farm adaptation trials on different crops and recommended one variety of tef (DZ-01-1285), eight bread wheat (*Shina, Galema, Kubsa, Hawi, Digelu, Jiru, Ketar* and *Et-13*), five sorghum (*Berhan, Meko, Teshale, Abshir* and *Gobyie*), six food barley (*Abay, Shege, Misirach, Mezezo, HB-42* and *Basso*), and four malting barley (*Beka, Holker, HB-52* and *HB-120*) varieties of cereals. Four varieties of faba bean (*Lalo, Dagim, Selale and Wayu*) and three of chickpea (*Akaki, Worku,* and *Mastewal*) and one variety of lentil (*Alemaya*) constitute improved technologies of pulses recommended for the target woredas of AMAREW addressed by the center. Similarly a range of varieties of horticultural crops including five varieties of potato (*Gorebella, Menagesha, Jalene, Shenkola* and *Gera*), and other leaf vegetables (Tables 8-10) was recommended by the center. The center has been particularly working hard on developing technologies that would enable farmers in the highlands of Ankober to produce seeds of the improved varieties of Swiss chard, carrot and head cabbage, which they have successfully achieved.

GARC: Despite the fact that the center is a relatively new center, 13 varieties of different crops have been recommended (Tables 8-10) after critically evaluating their adaptations under the harsh conditions of East Belessa, which is one of the dreadfully food insecure target woredas of the project. These include three tef (*DZ-01-196, DZ-Cr-37* and *DZ-01-974*), four varieties of sorghum (*Meko, Teshale Abshir* and *Abuare*), two varieties of cowpea (*MEL NI 963* and *White Wonder*) and one variety of chickpea (*Marye*) and three varieties of tomato (Royal ball, Melkashola and Melkasalsa).

Fig.8 Developing high yielding varieties of bread wheat by DBARC appropriate for the plain of Ensarona Wayu (now Seya Debrina Wayu) is another area of successful technological intervention accrued from the support of AMAREW. Despite the fact that the soil gets too wet and waterlogged during the main rain season, bread wheat production is a long-standing culture of the area. This is because, the farmers do traditionally drain excess water from their wheat field using hand-made broad bed and furrow (BBF) technique but lack of improved varieties has been the major constraint of production and productivity in the recent past.

Fig.9 Another important stride made by DBARC in the Vertisol plain of Seya Debrina Wayu is the introduction of alternative crops like faba bean into the farming systems which is traditionally very difficult to produce because of such diseases as black root rot which is severe under such water logging conditions. Production is now taking off for there are varieties tolerant to the disease and/or other effects of anaerobic conditions of water logging situations of Vertisols occurring in the midst of the cropping season. Above farmers were selecting among six improved varieties of faba bean (Lalo, Dagim, Degaga, Tesfa, Holetta-2 and Wayu-which is tolerant to black root rot) tested by the pulse team of the center against the local cultivar. They have selected Lalo, Dagim and Wayu, in the same order.

SARC: The center being one of the oldest centers of ARARI and is mandated for the two big zones of the region, North and South Wollo, which are in turn among the focal areas of AMAREW, is among the partner centers that have been working with the project right from the beginning. Quite a large number of varieties were proved, by the center with the support of AMAREW, to be commendable for the target woredas. These include: *DZ-Cr-37, DZ-01-196*, *DZ-01-974* and *Gola* for tef; *HAR 1685, HAR 1899* and *HAR 1775* for bread wheat; *Teshale, Meko, Yeju, Abshir, Gobyie* and *Berhan* for sorghum; *Misrach* for food barley; *Marye* for chickpea, *Asrat* and *Bekur* for cowpea; *Shulamith* for groundnut; *Adi* for sesame; *Coukra* and *Delta Pin* for cotton; *Menagesha* and *Tolcha* for potato; *Red Bombay* for onion and *Melkashola* and *Melkasalsa* for tomato (Tables 8-10).

Fig.10 *Demonstration of groundnut variety (Sedi) in Lenche Dima watershed by SARC.*

Fig.11 *One of the Striga-resistant sorghum varieties Gobyie, which along with others was tested and recommended by the research centers. This particular picture was taken from a field near Sirinka.*

SDARC: Despite the fact that the center is relatively a young one (became operational only some seven years a go) in the face of the grimly challenging conditions of Sekota, it has been actively and adequately involved in the activities of AMAREW. The center was able to extensively conduct a large number of adaptive experiments on different crops to find out best adapting ones and thereby improve the production and productivity of the farming systems in the area. Accordingly, it has come up with the following recommendations of crop varieties based on the results obtained from the research supported by the project. The varieties HAR-1920, HAR-2508, and HAR-2501, of bread wheat; *DZ-Cr-44* and DZ-01-99 of tef; *Abshir, Gobyie*, *Meko* and *Berhan* of sorghum and *Sinan* of triticale represent the recommendations on cereals while *Awash Melka 3, Roba-1* and *Tabor* of Haricot bean and *Asrat, Bekur* and *TVU-1977-OD1* of cowpea represent that of the pulses (Tables 8-10).

4.5 Technology scaling up

Since a number of crop technologies have been identified to have a significant impact in increasing production and productivity and thereby solving some critical problems of the farmers in the pilot woredas, it was felt essential that these technologies be scaled up/out so that the target groups can benefit more from the outputs of these technologies in a sustainable manner. Therefore, in the interest of the farmers, AMAREW and its partners in general decided that the year 2007 to be the year of scaling up of project-results and outcomes already identified and proved are most momentous. In this respect, the partner centers as well as the farmers and extension workers have identified the technologies that should be scaled up in their respective woredas during 2007 (Table 11). Hence ADARC has done the scaling up of technologies it has developed for potato, bread wheat and food barley in Lay Gayint. DBARC on bread wheat, chickpea, lentil and faba bean in the plains of Ensarona Wayu while those of food barley and potato in the highlands of Ankober. Furthermore, DBARC has scaled up the technologies developed for the production of seeds of different vegetables in the cool highlands of Ankober. GARC did on sorghum, tef and chickpea in East Belessa while SDARC has done on wheat, tef and sorghum. SARC has done the scaling up of the technologies of tef, groundnut and chickpea in Guba Lafto and of tef, bread wheat and chickpea in Tehuledere.

The scaling up activities are also envisaged to lay a foundation for strengthening the informal seed sector as an alternative scheme of improved seed source which is at present the major bottleneck of increased production and productivity in the country in general and in the region in particular.

Table 6. Number of experiments (on-going and new), by different sectors and years, supported by AMAREW and conducted by partner research centers over the period from 2003 to 2007

Center	Sector	Year					Sub Total	All centers and years	
		2003	2004	2005	2006	2007		Sub Total (number)	Percent
	Crops	48	17	20	7	5	97	Crops	
	Livestock	3		-	-	-	3		
	Natural Resources	-	3	-	-	-	3		
	Economics	-	1	-	-	-	1		
	Sub Total	**51**	**21**	**20**	**7**	**5**	**104**	**344**	**74.3**
DBARC	Crops	35	5	7	10	11	68	Livestock	
	Livestock	3	2	1	2	-	8		
	Natural Resources	2	3	2	2	-	9		
	Economics	-		-	-	-	0		
	Sub Total	**40**	**10**	**10**	**14**	**11**	**85**	**51**	**11**
GARC	Crops	-		-	12	4	16	Natural Resources	
	Livestock	-		-	5	3	8		
	Natural Resources	-		-	7	3	10		
	Economics	-		-		-	0		
	Sub Total	**0**	**0**	**0**	**24**	**10**	**34**	**61**	**13.2**
SARC	Crops	17	30	25	32	6	110	Economics	
	Livestock	4		3	2	2	11		
	Natural Resources	4	3	6	7	-	20		
	Economics	-		3	3	-	6		
	Sub Total	**25**	**33**	**37**	**44**	**8**	**147**	**7**	**1.5**
SDARC	Crops	12	12	16	7	6	53	Total	
	Livestock	-	2	11	6	2	21		
	Natural Resources	-	7	7	3	2	19		
	Economics	-		-	-	-	0		
	Sub Total	**12**	**21**	**34**	**16**	**10**	**91**	**463**	**100**
Grand Total		**128**	**85**	**101**	**105**	**44**	**463**		

Table 7. Total number of experiments conducted by partner research centers with the support of AMAREW Project by category and sector over the period of 2003-2007

Center	Category of Trial/Activity	Sector			
		Crops	*Livestock*	*Natural Resources*	*Total*
Adet	Adaptive	24	2	3	29
	Demonstrative	37	-	-	37
	Verification	1	-	-	1
	Survey	-	-	-	-
	Marketing	-	-	-	-
	Scaling up	3	-	-	3
	Empowerment (Seed/technology multiplication/ FREG, etc)	3	-	-	3
	Sub Total	**68**	**2**	**3**	**73**
Debre Berhan	Adaptive	14	4	5	23
	Demonstrative	15	-	-	15
	Verification	10	-	-	10
	Survey	-	-	-	-
	Marketing	1	-	-	1
	Scaling up	6	-	-	6
	Empowerment (Seed/technology multiplication/ FREG, etc)	3	-	-	3
	Sub Total	**49**	**4**	**5**	**58**
Gondar	Adaptive	2	-	4	6
	Demonstrative	1	-	1	2
	Verification	-	-	-	-
	Survey	1	2	2	5
	Marketing	-	-	-	-
	Scaling up	3	-	-	3
	Empowerment (Seed/technology multiplication/ FREG, etc)	-	-	-	-
	Sub Total	**7**	**2**	**7**	**16**
Sirinka	Adaptive	27	5	8	40
	Demonstrative	27	3	3	33
	Verification	1	-	-	1
	Survey	2	2	4	8
	Marketing	1	-	-	1
	Scaling up	6	-	-	6
	Empowerment (Seed/technology multiplication/ FREG, etc)	3	-	-	3
	Sub-Total	**67**	**10**	**15**	**92**
Sekota	Adaptive	17	8	4	29
	Demonstrative	6	1	3	10
	Verification	2	-	1	3
	Survey	-	4	2	6
	Marketing	-	-	-	-
	Scaling up	3	-	-	3
	Empowerment (Seed/technology multiplication/ FREG, etc)	-	-	-	-
	Sub-Total	**28**	**13**	**10**	**51**

Table 7. Contn'd

Grand Total	Adaptive	84	19	24	138
	Demonstrative	86	4	7	97
	Verification	14	0	3	17
	Survey	3	8	6	17
	Marketing	2	0	0	2
	Scaling up	21	0	0	21
	Empowerment (Seed/technology multiplication/ Awareness, FREG, etc)	9	0	0	9
	Grand Total	**219**	**31**	**40**	**290**
	Percent (%)	**75**	**11**	**14**	**100**

Table 8. Number of technological recommendations, by center and sector, developed through the support of AMAREW Project over the period of 2003-2007

Technology	Research Center					Total
	ADARC	DBARC	GARC	SARC	SDARC	
Natural Resources						
• Forestry and agroforestry	-	-	-	2	2	4
• Area closure	1	1	-	-	-	2
• Water harvesting	1	1	-	1	-	3
• Irrigation systems	-	1	-	-	-	1
• Soil and water conservation	-	-	-	1	1	2
• Wheel-water lifting	-	-	-	1	-	1
Total	2	3	-	5	3	13
Live stock						
• Small ruminants	-	2	-	-	1	3
• Poultry	-	1	-	-	-	1
• Apiary	-		1	-	1	2
• Forage	-	1	-	2	3*	6
Total	-	4	1	2	5	12
Crops						
• Cereals	16	24	7	14	10	71
• Pulses	5	8	3	3	6	25
• Oilseeds	3	-	-	2	-	5
• Vegetables	3	10	3	5	-	21
• Fiber crops	-	-	-	2	-	2
Total	27	42	13	26	16	124

* Same varieties of cowpea registered under pulses

Table 9. The number of crop varieties recommended along with their full production practices by the different centers with the support of AMAREW

Crop	*Research Center*				
Cereals	*ADARC*	*DBARC*	*GARC*	*SARC*	*SDARC*
Tef	-	1	3	4	2
Bread wheat	9	8	-	3	3
Sorghum	-	5	4	6	4
Food barley	3	6	-	1	-
Malt barley	-	4	-	-	-
Triticale	2	-	-	-	1
Total	16	24	7	14	10
Pulses					
Faba bean	4	4	-	-	-
Chickpea	1	3	1	1	-
Lentils	-	1	-	-	-
Haricot bean	-	-	-	-	3
Cow pea	-	-	2	2	3
Total	5	8	3	3	6
Oil Crops					
Groundnut	-	-	-	1	-
Linseed	3	-	-	-	-
Sesame	-	-	-	1	-
Total	3	-	-	4	-
Fiber Crops					
Cotton	-	-	-	2	-
Total	-	-	-	2	-
Horticultural Crops					
Potato	3	5	-	2	-
Swiss chard	-	1	-	-	-
Cabbage	-	1	-	-	-
Carrot	-	2	-	-	-
Tomato	-	-	3	2	-
Onion	-	-	-	1	-
Garlic	-	1	-	-	-
Total	3	10	3	5	-
Grand Total	27	42	13	26	16

Table 10. Names and productivities of crop varieties recommended for the target woredas along with their full production practices by the different centers with the support of AMAREW

Crop	S. No	Variety Name	Yield	Merit over the local	Center	Recommended for
Cereals			(q/ha)			
Bread wheat	1	HAR-1868 (Shina)	40	9	ADARC, DBARC	Lay Gayint, North Shewa
	2	Taye			ADARC	Lay Gayint
	3	HAR-3646 (Senkegna)			ADARC	Lay Gayint
	4	HAR-604 (Galema)	30, 40	6	ADARC, DBARC	Simada, Lay Gayint, North Shewa
	5	HAR- 1685 (Kubsa)	13.5-38	9.	ADARC, DBARC, GARC, SDARC, SARC	Simada, Lay Gayint, Sekota, North Shewa, Delanta
	6	ET-13 (Global)			ADARC, DBARC	Lay Gayint, North Shewa
	7	HAR-2501 (Hawi)			DBARC	Ensarona Wayu
	8	HAR-2896 (Jiru)	29	5	DBARC	Ensarona Wayu
	9	HAR-3116 (Digelu)			DBARC	Ensarona Wayu
	10	HAR-1899 (Ketar)	34	5	DBARC, SARC	North Shewa, Delanta
	11	HAR 2536	35		ADARC	Simada
	12	HAR 2029	32		ADARC	Simada
	13	HAR-1775	30		ADARC, SARC	Simada, Delanta
	14	HAR-1920	14	10.2	SDARC	Sekota
	15	HAR-2508	14	10.2	SDARC	Sekota
	16	HAR-2501	13	9.2	SDARC	Sekota
Tef	1	DZ-01-1285	16	1	DBARC	Efratana Gidim
	2	DZ-01-196	7.0	1.9	GARC, SARC	East Belessa,
	3	DZ-01-974	8.2	3.1	GARC, SARC	East Belessa,
	4	DZ-Cr-37	8.6	3.5	GARC, SARC	East Belessa,
	5	Gola			SARC	
	6	DZ-Cr-44	5	1.3	SDARC	Sekota
	7	DZ-01-99	5	1.3	SDARC	Sekota
Sorghum	1	Berhan	17-27	7-13	DBARC, SDARC, SARC	Efratana Gidim, Lowlands of Wollo, Sekota
	2	Meko-1	10-30	3-14.5	DBARC, GARC, SDARC, SARC	Efratana Gidim, Ebelessa, East Belessa, Sekota, Lowlands of Wollo
	3	Gobyie	16- 27	2- 12	DBARC, SDARC, SARC	Efratana Gidim, Sekota Lowlands of Wollo

	4	Teshale	9- 38	2	DBARC, GARC, SARC	Efratana Gidim, East Belessa, Lowlands of Wollo
	5	Abshir	17	13	DBARC, GARC, SDARC, SARC	Efratana Gidim, East Belessa, Sekota Lowlands of Wollo
	6	Abuare	12	5	GARC	East Belessa
	7	Yeju	30		SARC	Lowlands of Wollo
Food barley	1	Mulu	35		ADARC	Lay Gayint
	2	Shedeho	14- 33		ADARC	Simada, Lay Gayint
	3	Setegn	13.7		ADARC	Simada
	4	Abay	41	6	DBARC	North Shewa
	5	Shege	43	8	DBARC	North Shewa
	6	Misirach	37/28*	2	DBARC, SARC	North Shewa, Delanta
	7	Mezezo	40	5	DBARC	North Shewa
	8	HB-42	40	5	DBARC	North Shewa
	9	Basso	40	5	DBARC	North Shewa
Malting barley	1	Beka			DBARC	Ankober
	2	Holker			DBARC	Ankober
	3	HB-52			DBARC	Ankober
	4	HB-120			DBARC	Ankober
Triticale	1	Minet		-	ADARC	High rainfall areas
	2	Sinan	16	-	ADARC, SDARC	Drought prone areas
Pulses						
Faba bean	1	CS-20-DK	25		ADARC	Lay Gayint
	2	Degaga	26		ADARC	Lay Gayint
	3	Adet Hana			ADARC	Lay Gayint
	4	Mesay			ADARC	
	5	Lalo	36	16	DBARC	North Shewa
	6	Dagim	35	15	DBARC	North Shewa
	7	Wayu	29	9	DBARC	Ensarona Wayu
	8	Selale	23	3	DBARC	Ensarona Wayu
Chickpea	1	Marye			ADARC, GARC, SARC	
	2	Akaki			DBARC	Ensarona Wayu
	3	Worku			DBARC	Ensarona Wayu
	4	Mastewal	30		DBARC	Ensarona Wayu
Lentil	1	Alemaya	20-25		DBARC	Ensarona Wayu
Haricot bean	1	Awash Melka-3	10	6	SDARC	Sekota
	2	Roba-1	9	5	SDARC	Sekota
	3	Tabor	9	5	SDARC	Sekota

Cowpea	1	Asrat	12	-	SARC, SDARC	Sekota
	2	Bekur	12	-	SARC, SDARC	Sekota
	3	TVU-1977-ODI	11	-	SDARC	Sekota
	4	MEL NI 963	15	-	GARC	East Belessa
	5	White Wonder	15	-	GARC	East Belessa
Oilseeds						
Groundnut	1	Shulamith	40		SARC	Kobo, Lenche Dima
Sesame	1	Adi			SARC	Kobo, Lenche Dima
Linseed	1	Geregera			ADARC	Lay Gayint
	2	CI-1525			ADARC	Lay Gayint
	3	Berene			ADARC	Lay Gayint
Fiber Crops						
Cotton	1	Coukra			SARC	Kobo, Lenche Dima
	2	Delta Pin			SARC	Kobo, Lenche Dima
Vegetables						
Potato	1	Zengena	240	190	ADARC	Lay Gayint
	2	Guasa	235	185	ADARC	Lay Gayint
	3	Tolcha	168	118	ADARC, SARC	Lay Gayint, Delanta
	4	Gorebella	305	128	DBARC	North Shewa
	5	Gera	272	95	DBARC	North Shewa
	6	Menagesha	139	-	DBARC, SARC	North Shewa, Delanta
	7	Jalene	291	114	DBARC	North Shewa
	8	Shenkola	291	114	DBARC	North Shewa
Tomato	1	Royal Ball	425	-	GARC	East Belessa
	2	Melkashola	406	-	GARC, SARC	East Belessa,
	3	Melkasalsa	412	-	GARC, SARC	East Belessa,
Onion	1	Bombay Red			SARC	
Garlic	1	MM-98	71		DBARC	North Shewa
Swiss chard	1				DBARC	Ankober
Carrot	1	Nantus			DBARC	Ankober
	2	Chanteny			DBARC	Ankober
Cabbage	1	Copenhagen			DBARC	Ankober

* Belg and Meher seasons, respectively

Table 11. Improved technologies scaled up/out by partner research centers of ARARI with AMAREW Project funding in 2007

Technology for the scaling up/out	Agricultural Research Center implementing the scaling up						
	ADARC	DBARC		GARC	SARC		SDARC
	Lay Gayint	*Ankober*	*Siya*** *Debrina Wayu*	*East Belessa*	*Guba Lafto*	*Tehuledere*	*Sekota*
Cereals							
Bread wheat	✓	-	✓	-	-	✓	✓
Tef	-	-	-	✓	✓	✓	✓
Sorghum	-	-	-	✓	-	-	✓
Pulses							
Faba bean	✓	-	✓	-	-	-	-
Chickpea	-	-	✓	✓	✓	✓	-
Lentil	-	-	✓	-	-	-	-
Groundnut	-	-	-	-	✓	-	-
Horticulture							
Potato	✓	✓	-	-	-	-	-
Highland vegetables' seed production	-	✓	-	-	-	-	-

4.6 Achievements in livestock research

Table 6 shows that 51 of the 463 experiments conducted by the centers over the five years of the project's lifetime pertain to livestock sector. But as we said earlier, most of the experiments were long-term that they would be counted every year. But Table 7reveals that a total of 31 activities pertaining to adaptation and demonstration trials and surveys were conducted on livestock. These activities were all concerned about generating technologies or information primarily on small ruminants, poultry, apiary, and forage production (Table 8). Forage species such as vetch and oat and their nutritional regime for profitable sheep fattening for North Wollo conditions were established by SARC and also for sheep production in North Shewa by DBARC. The latter in fact did also demonstrations of improved breeds of sheep in North Shewa and South Wollo areas with the support of the project. Furthermore, SARC has identified appropriate species of Napier grass for the different woredas of Wollo.

Survey and monitoring of disease outbreak have been conducted on local and exotic chickens under farmers' management system in Northern Shewa by DBARC since

July 2003. The study was intended to investigate major poultry diseases and test or develop possible control strategies. Accordingly, some key health and production constraints, including infectious and parasitic poultry diseases, have been identified and also the effectiveness of antibiotics for infectious conditions and vaccine for viral diseases has been determined.

Furthermore, DBARC also conducted evaluation of community-based control strategies against foot rot disease in Sheep in North Shewa by identifying three groups of sheep about equally at risk for foot rot. Incidences were recorded and control strategies had been implemented. The first group (g1) had received foot bathing in 5% formalin solution. The second group (g2) had received conventional treatment (topical dressing and antibiotic spray) as the case appeared. No treatment for foot rot was given to the third group (g3). The results indicate that 5% formalin bathing was not effective for treatment of virulent foot rot, but helped to reduce incidences in the next season when used strategically as prophylactic. The conventional treatment of topical dressing and antibiotic spray was found the best in treating or controlling foot rot cases, especially the virulent ones. Management practices are also among the major factors determining the epidemiology of foot rot, such that farmers, who participated in the training given on control and preventive measures of foot rot, were found to be successful in reducing the case at large irrespective of the treatment type.

Fig.12 *The sheep flock under treatment being examined by the veterinarian at DBARC.*

Fig.13 *Abergelle goats, which are well adapted to the lowlands, have been distributed to AMAREW participating farmers in East Belessa.*

GARC and SDARC conducted survey works and have established facts on the status of apiculture, including the flora associated therewith and also different options of beehives, in and for their respective project areas. Both centers have also undertaken studies relevant to Abergelle goats. GARC, in conjunction with the WOARD of East Belessa, has introduced Abergelle goats to the area in a bid to improve production and reproduction capacity of the local flock and the study is in progress. SDARC after conducting a baseline survey on flock size and structure of Abergelle goats as well as general livestock composition in the sub-moist ecologies of Wag Himra has synthesized and documented the information. The survey result shows that goats, by constituting about 47% of the livestock resource in the zone, are most important followed by sheep (36%) and cattle (13%). The flock structure of goats exhibited that adult females constitute about 50%, kids 23%, young females 11% and the rest 16% is covered by adult and young bucks and castrated males. The center has also identified three cowpea varieties (*Asrat*, *Bekur* and *TVU-1977-OD1*) suitable for milk production of Abergelle goats.

4.7 Research-extension-farmer linkages

Agricultural development is, and should be, a dynamic process whereby a shift from traditional way of doing things as usual whereby researchers, extensionists and above all the farmers themselves work in isolation can no longer bring about aspired changes in the livelihood of the farming community. Being agricultural research and extension are essential components of the development process, the prime objective of both systems is to sustainably increase agricultural production and productivity, improve the food security and the living conditions of the farmers while at the same time maintaining and improving the natural resources base. Malfunctioning in any of these components can easily become a weak link of the development pathway. But, on the other hand, agricultural research-extension services in the country have always been constrained by weak institutional as well as functional links. Cognizant of this fact, AMAREW was trying its level best to help the research, extension, farmers and other stakeholders build, among themselves, a harmonized and lasting bond of partnership. A whole lot of different ways of supporting the actors was made by AMAREW in order to realize the long-awaited shift in research and extension linkage paradigm. The following, among others, constitute the major themes of activities, which have been supported by the project in order to address the problem of weak linkage.

4.7.1 Facilitation of joint review and planning workshops

AMAREW Project right from the beginning has been inexorably trying to foster synergistic institutional relationships between ARARI, BoARD, WOARDs and the relevant research centers in a bid to give lasting solutions of technological as well as knowledge options for the farmer through a concerted efforts of researchers, extension experts, development workers and above all the farmers, to work hand-in-hand towards achieving shared-vision and thus same goal. The project has been regularly organizing joint review and planning workshops which contributed to build the linkage by creating the platform whereby all the stakeholders including researchers, woreda agriculture office experts, development agents and farmers, in the presence of region- zone- and woreda-level officials or their representatives, took part in discussing and sharing experiences, identifying problems and challenges, suggesting best-bet solutions and options, and making decisions on furthering technologies and knowledge in a truly participatory manner. Such workshops were held at each woreda and every year at an appropriate time where the outcomes could be used as inputs for decisions to be made at higher zonal or regional levels. Therefore, the exercise of the joint planning has not only served to strengthen linkages at various levels, but also helped to ensure the making of development decisions by the higher bodies of partners, which are relevant to the target groups.


Fig.14 *Joint plannings taking place at Guala Town in East Belessa (left) during 12-14 October 2006 and Nefas Mewcha in Lay Gayint (right) during 16-18 October2006. Among the participants were present representatives from the BoARD and zone-level officials who, after seeing the practicality and earnest move of the project to instill the process of participatory community driven planning and implementation, will presumably play pivotal role to influence higher officials in institutionalizing effective and lasting research-extension-farmer linkages.*

Fig.15 *Debre Berhan Research Center has played an exemplary role to fully exploit the opportunity created by the support of the project to foster an effective linkage with its stakeholders. One such an opportunity is the forum of joint planning as in the picture here whereby the planning for 2007 was conducted with active participation of the farmers and extension personnel of Ankober Woreda during 14-15 November 2006. The enthusiasm and participation of WOARD was particularly encouraging although they are not direct beneficiary of AMAREW.*

4.7.2 Facilitation of field days and joint evaluations

AMAREW as much as possible has made efforts to create a platform whereby all stakeholders would also jointly evaluate research activities that have been jointly planned. One of such platforms intrinsically intended to foster stronger linkages between them was by supporting the organization of field days by all centers. All the partner centers were able to hold at least one field day every year whereby implementations of plans were scrutinized by the various partners and also the merits of technological options would be judged by the farmers at field-levels using their own assessment criteria.

Fig.16 *Farmers, researchers, extension experts and DAs evaluating sorghum varieties tested at Achikan in East Belessa. Such a joint evaluation exercise has been found an effective forum for strengthening inter-institutional linkages.*

Fig.17 *ADARC right from the beginning of AMAREW has been persistently working in close collaboration with the WOARD at Lay Gayint to instill the essence of participatory planning and evaluation of on-farm activities that it has been carrying out with the support of AMAREW. Among the many crop varieties the center has tested and recommended for the area include: bread wheat (top left) and, linseed (top right. The recommendations were fundamentally based on the joint evaluations and decisions made by the farmers themselves as could be discerned from the pictures.*

Fig.18 *FREG members at Seya Debrina Wayu organized and facilitated by the socio-economics and research and extension team of DBARC, (Ato Tilaye Teklewold, the Head of the Department and the vanguard of the AMAREW-supported projects in the center seen from the back on the photo), while evaluating and selecting among the chickpea varieties tested.*

4.7.3 Facilitation of the establishment of RETCs

In its effort to meet one of the objectives set at the beginning of the project, which is bringing about a paradigm shift in the arena of research-extension linkage within ANRS, AMAREW has devised different ways towards that end. One of these ways is to encourage and support the partner research centers and WOARDs to establish woreda-level Research-Extension Technical Committee (RETC). Three workshops were organized by the project in March-April 2006 at Bahir Dar, Dessie and Debre Berhan whereby participants were drawn from both the research centers and the respective woredas including the heads of the institutions in order to materialize the establishment of RETCs. The project has even prepared draft terms of agreement to be signed by the heads of the centers and WOARDs of the pilot areas. Informal as they may be, the committees were established at Sekota, East Belessa and Debre Berhan and are working to date.

In pursuant to influence decision makers at region-level, AMAREW, in collaboration with all its stakeholders, plans to organize a critical workshop to share the experience thus far gained at grassroots level and thereby address this important issue at the highest level in the region. It is hoped that a working mechanism will be designed during this workshop leading to a long-awaited

mega decision of institutionalizing the norm of research-extension-farmer linkage in planning, implementing and evaluating rural development pathway.

4.8 Community empowerment

In this context, community empowerment means that individual members of the community or groups of individuals from the community are assisted to acquire the power or capacity to think and act freely, exercise choices, and fulfill their needs by sustainably taping resource potentials readily available for the members of the society. The research component of AMAREW focused on two major issues as a source of community empowerment. These are: (i) establishment of informal schemes of technology multiplication especially multiplications of improved crop varieties; and (ii) establishment of action groups of farmers to enhance the processes of developing appropriate technologies and also promote the transfer of viable technologies. Summaries of the activities undertaken on this line are discussed hereunder.

4.8.1 Strengthening the informal seed multiplication scheme

While a sustainable supply of high quality seeds of improved crop varieties is an essential input for increasing production and productivity, the existence of such a scheme in the country in general is rather skimpy. The only parastatal firm formally producing improved seeds in the country is the Ethiopian Seed Enterprise (ESE), which is engaged in the production and distribution of improved seeds of very limited number of crops, mainly few cereals, which could cover only a little more than 5% of what is required as planting material. Planting materials or seeds for the great majority of crops such as pulses, oilseeds, vegetables especially potato are not produced formally at all. In order to mitigate the existing gap between the demand for high-quality seed of improved varieties of a long list of crops on one hand and a very limited number of species covered by the formal seed sector on the other, AMAREW has been trying to strengthen the informal seed sector by assisting various activities of the research centers. Three different categories of activities that have been supported by the project could be recognized in this respect, which are discussed hereunder.

Community-based seed multiplication of crop varieties: As has been said earlier, lack of improved seed has been the major constraint of production and productivity not only of the region but also of the country in general. Given the fact that most of the pilot woredas of AMAREW are drought-prone and also are far from the seed production areas of the ESE, the problem of lack of basic seeds of even the major cereals is exceptionally critical. As an alternative means of alleviating this strategic setback AMAREW has been encouraging the partner centers to launch community-based seed multiplication of improved varieties of crops. Consequently, the partner centers have indulged themselves with establishing community-based schemes of seed production such as ADARC with

bread wheat, linseed and faba bean, GARC, SARC and SDARC with striga-resistant varieties of sorghum and tef, and DBARC with bread wheat, faba bean, chickpea and potato. In order to make best use of these technologies in a sustainable manner, a scaling up program has been launched during 2007. The scaling up activities are expected to virtually develop into effective seed firms.

Establishment of Collective Seed Production and Marketing Groups: Among the pilot areas of AMAREW, Lay Gayint and Gumet watershed in Sekela are suitable for potato production especially for seed potato since there is a relatively low disease pressure. In view of improving the income generation capacities of the community, the project took the initiative of organizing few numbers of farmers willing to produce seed potato. Only seven farmers volunteered to try new varieties and thus seven improved varieties were provided to them, which were grown during August-December 2006 producing some 80 quintals. The project has supported the growers by providing them trainings and construction of a 200m^2 Defused Light Store (DLS) as it is a critical input for sustainable production of seed potato. Having seen the productivity, over 80 farmers were registered to get the seed for the next planting which they did but only 37 of them were able to produce an acceptable standard of seed potato of over 250 quintals (Table 8). At a price of 300 Birr/quintal (which is even lower than the average price for seed potato), each farmer managed to get 3000-3600 Birr. In order to ensure continuity of the benefit by the community, the project is intending to organize these farmers into three groups of 10-12 individuals each, equip them with the knowledge base through trainings, cross-site visits, encouraging them to possess their own DLS individually and most importantly linking them with the ware potato producers that will be organized to feed the impending dehydration plant to be established in the area. A similar scheme of work has been started at Lay Gayint by ADARC.

Fig.19 *AMAREW has introduced improved technologies of seed potato along with other technologies of watershed management and crop production to the Gumet watershed community for the first time. Potato can be produced in the Gumet watershed three times a year. The major production is during the main rain season where planting is done in March-April and harvesting in August. The second possibility is during the August-November period using the residual soil moisture and with some supplementary irrigation and the third is during the January-May period exclusively with irrigation. This particular photo is from the later planting. Together with the other 34 farmers who grew seed potato during the season farmer Nebiyu Tibebu (top) has submitted 13 quintals of high-quality seed potato (worth 3900 Birr) to the WOARD for storage in the DLS built with the support of AMAREW (bottom). A total of 253 quintals of seed potato was submitted in the same way from the farmers that are going to be organized into three groups of seed potato producers which eventually are aspired to develop into community-based seed enterprises.*

Table12 Gumet watershed irrigated seed potato produced and disseminated in 2006/07

S.No	Name	Sex	Sub Kebele	Got'	Area planted (m^2)	Variety	Yield		
							Harvested (kg)	Submitted (kg)	Converted (q/ha)
1	Abebe Alehegn	M	Sawsa	Debregna	450	Zengena	425	400	94
2	Adis Abesha	M	Godir	L/Ambero	450	Zengena	500	500	111
3	Alehegn Aysheshim	M	Sawsa	Debregna	450	Zengena	300	300	67
4	Alehegn Hailu	M	Godir	L/Ambero	450	Zengena	500	400	111
5	Alemu Yihun	M	Godir	L/Ambero	450	Guasa	650	600	144
6	Animut Alehegn	M	Sawsa	Debregna	450	Zengena	500	500	111
7	Ayalew Tibebu	M	Sawsa	Debregna	450	Jalene	800	800	178
8	Ayenew Mekonnen	M	Sawsa	Tintegala	500	Gorebella	955	900	191
9	Biresaw Guadu	M	Sawsa	Tintegala	450	Marachere	742	700	165
10	Birku Alem	M	Sawsa	Debregna	450	Marachere	815	700	181

11	Bogale Almaw	M	Sawsa	Aydegerel	500	Gorebella	635	600	127
12	Fenta Berihun	M	Sawsa	Debregna	900	Gera	893	800	99
13	K/Klemu Tibebeu	M	Sawsa	Debregna	450	Gera	642	600	143
14	K/Demelash Belay	M	Sawsa	Debregna	450	Jalene	480	400	107
15	K/Dese Senay	M	Sawsa	Debregna	450	Marachere	561	500	125
16	K/Nebiyu Ayalew	M	Sawsa	Debregna	450	Gera	700	700	156
	"	"	"	"	450	Guasa	567	567	126
17	Lakew Asreda	M	Sawsa	Wereita	500	Gorebella	1000	1000	200
18	Lijalem Ayana	M	Sawsa	Debregna	450	Jalene	700	700	156
19	M/Mengesha Chere	M	Godir	Ashalta	450	Marachere	600	600	133
20	Mekuriaw Senay	M	Sawsa	Debregna	450	Zengena	690	500	153
21	Mengist Liyh	M	Sawsa	Debregna	900	Jalene	1930	1900**	214
22	Mulat Meless	M	Godir	Keista	450	Jalene	500	500	111
23	Nebiyu Tibebu	M	Sawsa	Debregna	450	Guasa	1300	1100	289
24	Sharew Wube	M	Godir	L/Ambero	450	Zengena	1050	900	229
25	Shita Zerihun	M	Sawsa	Debregna	900	Gera	1400	1200**	311
26	Sinishaw Migbaru	M	Godir	L/Ambero	450	Guasa	600	500	133
27	Tadesse Emire	M	Sawsa	Debregna	450	Jalene	680	500	151
28	Tibeyin Worke	F	Sawsa	Debregna	450	Gera	600	600	133
	"	"	"	"	450	Marachere	600	600	133
29	Wale Ayana	M	Sawsa	Debregna	450	Jalene	942	900	188
30	W/ro Enat Mulu	F	Sawsa	Debregna	450	Marachere	400	400	89
31	Yigarde Fetene	F	Sawsa	Debregna	450	Gera	700	700	156
32	Zerihun Fenta	M	Godir	L/Ambro	500	Gorebella	640	600	128
33	Zerihun Kebede	M	Godir	L/Ambero	450	Zengena	450	400	100
34	Zewde Boge	F	Godir	L/Ambro	450	Wechecha	685	685	152
35	Zigale Terefe	M	Sawsa	Debregna	450	Gera	497	400	110
Total							**-**	**25352**	**-**

Note:. *K = when appears before names is to represent the title "Keis" (priest) and similarly M to represent "Merigeta", Some farmers have grown more than one variety and thus their names appear more than once under each variety they have grown.* ** *Returned 2 quintals for the revolving seed. From the total submitted, 40 quintals constitute the revolving seed*

Organization of farmers who produce highland vegetable seeds: Another successful area of action research endeavor supported by AMAREW includes the augmentation of value-chains in the production of highland vegetables initiated and implemented by DBARC. Since very recently the production and consumption of vegetables such as cabbage, Swiss chard, and carrot especially by the rural community are fast becoming popular. This is indeed a leap forward particularly in view of the food habit of the great majority of the rural population in general and of the region in particular. Supplementing the nutrition with vegetable sources will certainly bring about a significant advantage in the health as well as economy of the farmer. But on the other hand the planting material for these vegetables has to be imported often at unaffordable prices. DBARC in search of a practical solution for the problem has identified appropriate varieties and practices that will enable the farmer to produce seeds for the highland vegetables as could be learned from the photo below.

Fig.20 One of the interventions that DBARC has made is the introduction of technologies of vegetable production primarily for seed production and of course for consumption. In this regard the center is successful in identifying species (Swiss chard, carrot and head or common cabbage) which could bear seeds as high as 16 q/ha which is worth thousands of Birr and that is often imported from abroad. It is also possible for the farmers to consume vegetable relish from the same plants. Ankober is such a suitable area for the cool season vegetables to set seeds in a relatively short time span and production of vegetables for seed will be a lasting venture once the markets are properly linked on which the center is diligently working. FREGs have been established and the members are well trained and have started producing their own seeds. Ato Semagn (front) says that except the red beetroot, for the Swiss chard, carrot and cabbage the seed produced by the center is as good as or even better than the seed imported.

4.8.2 Establishment of farmers research and extension groups (FREGs)

National as well as regional experiences show that FREGs provide a platform whereby the farming community can voluntarily pool their efforts, knowledge and scarce resources together to accomplish tasks more effectively and efficiently and thus secure more advantages than would be achieved individually. Such positive experiences and the trainings organized and given on the subject by AMAREW inspired all the research centers and their WOARD partners to establish FREGs, in their respective mandate woredas. Accordingly, ADARC established two FREGs at Gobgob and Yedero Kebeles with members of 25 and 30 respectively. While 10 female farmers constitute part of the members of the FREG at Gobgob, 15 females are members of the FREG at Yedero. Similarly, GARC has established three of such groups one each on sorghum, tef and Abergelle goats in

three kebeles in East Belessa. Each of the FREGs has 20-25 farmers of which 10 are females. SDARC has also established two FREGs in its mandate woreda, Sekota. One of the FREGs established by SDARC is outside the mandate area of AMAREW indicating that the endeavors of the project, especially those improving the research-extension linkage, are assuming a better course of action and the stakeholders at different levels should capitalize on this positive stance so that the approach can be internalized by the respective partner-institutions. Similarly DBARC has established FREGs for cool-season vegetable seed production at Ankober and for different crops at Seya Debrina Wayu.

5. Small Grants and Mentorship Program (SGMP)

AMAREW has been providing funding opportunities, from the Contractor's portion of the funds, for implementation of agricultural research and extension projects in the Amhara National Regional State (ANRS) through the competitive Small Grants and Mentorship Program (SGMP). SGMP was basically designed to promote the link between senior researchers of the Collaborative Research Support Program (CRSP) universities in the USA or CGIAR Centers and young researchers in the ANRS. Consequently, some ARARI researchers in collaboration with the staff from other regional partners have been conducting research under the scheme over the last several years. The projects financed by the program included: two projects on natural resources and one each on fishery and agricultural economics, and four projects on crops (Table 9). Four of the projects that have been approved in 2005 were supervised by expatriates from the CRSP Universities. Unlike the previous proposals, however, the mentor for each of the new projects approved in 2007 was selected from the local scientists with rich experiences in the respective subjects. A one-day (9 March 2007) workshop was held to assess the status of the four projects that are going on since 2005 and also to enter agreements between AMAREW and the principal investigators and thus officially launch the new projects.

Fig.21 Participants of the SGMP workshop, which was held on 9 March 2007 at AMAREW office in Bahir Dar. Arrows indicate the mentors from right to left Drs. Hailemichael Kidanemariam (Plant Breeder and Seed Specialist), Getachew Belay (Plant Breeder/Geneticist), Tesfaye Tesso (Plant Breeder and National Sorghum Research Coordinator), and Tesfaye Tessema (Senior Plant Breeder and Agronomist)

Table 13. Summary of the projects being conducted under the SGMP of AMAREW Project

S. No	Title	Principal Investigator/ Profession and Level of Education	Area of Investigation	Organization/ Center	Category of Investigation	Budget Approved (Birr)	Proposed Duration	Name and Affiliation of the Mentor
1	Assessment of soil characteristics, surface water qualities and water table fluctuations on selected irrigation command areas in east and west Gojam and Awi Zones	Mekonnen Getahun,	Natural resources	Bureau of Water Resources, ANRS	Basic/ Strategic	54,266	2005-2006	Dr Asmare Atalay, Prof. of Soil Sci., Virginia Tech, USA
2	Estimation of rill erosion using spatial rill damage and network assessment over hill slopes	Gizaw Desta, MSc	Agricultural engineering	ARARI/ DBARC	Basic/ Strategic	52,401	2005-2006	Dr Conrad D. Heatwole, Biological Systems Engineering, Virginia Tech, USA
3	Assessment of major threats of Lake Tana and strategies for integrated water use management	Miheret Endalew, BSc	Natural resources management	ARARI/ FARC	Strategic	53,664	2005-2006	Dr Ernest W. Tollner, Driftmier Engineering Center, Biological and Agricultural Engineering Department, University of Georgia, Athens, USA
4	Determining the optimal enterprise mix in crop-livestock integration for sustainable farming systems in the highlands of North Shewa, Amhara Region	Tilaye Teklewold, MSc	Agricultural economics	ARARI/ DBARC	Strategic	40,439	2005-2006	Dr. John McPeak, USA
5	Integrated Management of Potato Late Blight Through FFS	Agegnehu Shibabaw, BSc, Horticulture	Pathology	ARARI/ ADARC	Applied	44650	2007	Dr Hailemichael Kidanemariam
6	Scaling out Early-Maturing and Striga-Resistant Sorghum Varieties with their Full Packages in Drought- and	Kebede Teshome, MSc,	Breeding/ Extension	ARARI/ SARC	Applied/ Scaling up	45000	2007	Dr Tesfaye Tesso, EIAR, MARC

	Striga-Prone Areas							
7	Durum wheat promotion in potential areas of Northwestern Ethiopia	Tadesse Dessalegn, PhD	Plant Breeding,	ARARI/ ADARC	Scaling up	46000	2007	Dr Tesfaye Tessema, SG2000
8	The relative contribution of bread wheat varieties, nitrogen fertilizer and environments to bread –making qualities in the highland Vertisols of North Shewa, Ethiopia	Adamu Molla,		ARARI/DBARC	Strategic	50000	2007	Dr Getachew Belay, EIAR, DZARC

Spatial rill initiation and rill network with and without tillage furrow conditions in the highlands of North Shewa, Ethiopia

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Abstract

To control soil erosion, it is important to know specific erosion processes under different soils, topography and rainfall regimes. But little or no research was done on specific erosion processes that help to plan control measures. Rills are used to describe small forms of linear erosion, which result from hydraulic erosion by overland flow. Studying the processes of rill erosion would enable to identify the critical locations of erosion along the topo-sequence. Therefore, this study was conducted to identify rill prone areas in terms of topographic parameters where control measures to be planned and characterize the rill initiation and rill development under conventional tillage roughness condition. The study was carried out at *Andit Tid* Watershed (North Shewa) on a bare cultivated field condition immediately after tillage by considering conventional tillage induced roughness and relatively smooth soil surface. Measurement of rill characteristics and tillage gradient and direction was done by a field survey along transect every 2m slope length. The rill characteristics and the effect of slope and tillage roughness that lead to erosion damage are described and known. The cause of temporal variation of rills was also investigated. The form and size of rills vary according to the slope angle and shape, tillage pattern, and runoff contributing area within fields. Rill characteristics data showed that rill initiation and development is mostly related to the slope and shape of the field. Rill initiation and its dimension vary greatly between fields with tillage-induced roughness and without or relatively smooth roughness conditions. The distribution of rill initiation versus furrow number counted down slope showed that the furrow length where break point occurred decreased as the number of furrows increased down the slope. The distribution in the number of initial rills was also increased as furrows increased. About 40 % of initial rills occurred in the first top section of the field and when considering all individual rills in all transects 52 % occurred in the range of 0-6 m slope length. Width of rills was highly increased down wards with smooth than with rough surface conditions. As a result of width increment, the depth to width ratio was also decreased from top to down slope. The percentage of merged rills with respect to the total individual or initial rills was equal for smooth and rough surfaces (47 % and 45 %). Whereas the percentage of merged rills with respect to those individual rills contributing to the network on smooth surface was higher than on rough surface (78 % and 66 %). The probability of rill formation on rough surface was high. On the contrary, more success of individual rills to form the rill network has been observed on relatively smooth surface. Comparison of initial and confluence rills indicated that a 3-4 cm increase in the width of rills and 0.5-1 cm increase in depth was observed when two or more rills combined. At early storms, the scouring of merged rills was increased starting from 6 m down the slope and became stable at bottom part of the plot where deposition has observed. At the end of August, the

ratio was increased up to 16 m and then decreased. The depth to width ratio was between 0.30 and 0.50 where two and more rills merged except less value was measured on the upper part. In general, the rill network has shown clear temporal development.

Assessment of Major Threats of Lake Tana and Strategies for Integrated Water Use Management

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Abstract

The character of aquatic resources and the hydrologic regime of Lake Tana watershed is dependent on natural factors (climate, geomorphology and geology, and vegetation cover) and human activities (water use, land use, waste disposal, physical modifications, corridor engineering, urbanization etc.) inducing increased instability in the aquatic ecosystem of the lake. The assessment of major threats of Lake Tana and strategies for integrated water use management research targets to identify and characterize different activities in the watershed of Lake Tana. Special attention concentrates on the activities that impose potential threats on the lake ecosystem. The objectives of the research is to identify and characterize the different activities that are carried out in the watershed and how these activities are managed to minimize the potential risks to the lake resources and the wetland system. The collection of different data in the Lake Tana watershed *Woredas* is done through questionnaire field survey. At this time 80 % Lake Tana watershed, *Woredas'* data is collected. The Ethiopian Meteorological Service Agency provided the meteorological data of Lake Tana watershed. The remaining 20 % watershed *Woredas*' and other supportive data will be collected. The Geographic Information System/GIS format will be used for data analysis to map out and ease communication among the potential stakeholders. The results of the research will serve as a springboard to the potential stakeholders implementing different development activities in the watershed. The result of the research also gives clue to develop an integrated plan of development and establish monitoring and evaluating mechanism to mitigate the potential threats at possible minimized level to sustain the well being of the lake ecosystem serving its multipurpose use for the present and the next generations.

Preliminary Assessment of Soil and Water Qualities at Irrigation Command Areas in East and West Gojjam

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Abstract

In areas where rain fed agriculture is unreliable due to erratic nature of rainfall patterns, irrigation plays key roles in achieving food security and sustainable development. Such

scenarios are currently facing the Amhara National Region State as well as the country whereby millions of people are forced to depend on external food aid. On the other hand, the region has tremendous irrigation potential, which is yet to be tapped if the current trends of food deficits are to be reversed. Irrigation promotion without appropriate safeguards can lead to, negative impacts on ecosystem and environment and need to be closely monitored and mitigated accordingly. Environmental hazards caused by improper practices and poor management of irrigation water can have detrimental undermine the productivity of land. Such negative environmental impacts can also extend beyond the irrigation schemes and affect the ecosystem and other downstream water users. If improperly implemented the negative impact of irrigation outweighs its positive contribution to the people's livelihood. Even though a number of irrigation schemes have already been developed, in Amhara Region no systematic soil and water quality studies are implemented to evaluate the sustainable use of irrigation schemes. This could have developed useful information in identifying and mitigating the negative impacts and future irrigation projects. Such a study would be overcome by taking similar samples in starting any irrigation activities, which could be overcome by taking similar samples in adjacent fields, where irrigation has not been practiced. Therefore, this study is initiating to quantify biophysical and socio-economic impacts of constructed irrigation schemes such as Jedeb, Geray, Fetam and Mendel and Tiqurit by examining main physical and chemical properties of soils at the irrigated and non-irrigated command areas, assessing the quality of water bodies used for irrigation purposes, identify cost effective options for excess water disposal from irrigated land, generate valuable information for the future irrigation schemes development resulted in water logging and other problems in irrigated lands and recommending appropriate measures to mitigate such negative impacts. Based on results obtained, suggestion will be made on future research and development needs.

Determining the Optimal Enterprise Mix in Crop-livestock Integration for Sustainable Farming Systems in the Highlands of North Shewa, Amahra Region

Tiralye Teklwold Deneke and Johm Mcpeak, USA

ABSTRACT

Like in most highland areas of Ethiopia, mixed crop livestock farming system farming predominates in North Sehwa zone of Amhara region. However, with increasing population pressure and land scarcity, competition for scarce resource develops, and hence crop production is leading to increased competition for land so that a contradiction of the areas of grazing lands for livestock production, where the later being equally important and potential for the generation of income and food security as the first for the smallholder farmers in the highlands of north sehwa. Hence it was proposed to determine the economic optimum level of integration of crop and livestock in mixed crop-livestock farming system of north shewa. Both primary and secondary data were collected for this study. Secondary information was collected from the District Office of Agriculture and *Debere Berhan* Agricultural Research Center on farm database. Primary data was gathered from farmers field by way of formal survey through trained enumerators. At present, this study is at its final stage of data analysis. Analysis of data involves descriptive statistics, cost benefit analysis and mixed linear programming mode. To undertake the mathematical programming, first production functions have to be determined and stochastic frontier analysis is used for this purpose. What remains now is

finalizing the remaining data analysis and report. This will be done in the coming four months time.

Scaling Out of Integrated *Striga* and Drought Management - Packages to Enhance Sorghum Production in North-Eastern Ethiopia

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Abstract

Sorghum is the second most important food crop next to tef in North Eastern Ethiopia. The crop has a multitude of uses where the grain is used for food and local beverages, and the stalk is used for syrup, feed, fuel, construction and even as a cash source. Efforts have been made by Sirinka Agricultural Research Center to find improved sorghum varieties for low moisture stress locations and *striga* infested arable lands to boost sorghum production per unit area. Accordingly, two early maturing and high yielding varieties namely *Yeju* and *Teshal*, and one *striga* resistant sorghum variety which is called *Hormat* were recently released for Eastern Amhara Region. With the support of AMAREW Project, efforts were continued to disseminate the improved sorghum varieties along with other sorghum technologies for selected locations in Kobo, Habru and Dawa Chefa weredas. At the beginning of the scaling up project implementation, potential sorghum growing locations were identified with the assistances of Office of Agriculture and Rural Development in the three weredas. Accordingly, six kebeles from Kobo, two kebeles from Habru and three kebeles from Daw Chefa weredas were selected. Gobye (020), Robit (012), Aradom (08), Abuare (07), Kobo zure (01) and Mendefera (06) were the selected kebeles in Kobo; Girana (018) and Lipso (014) were the selected kebeles in Habru; and Bedeno, Gerbi and Shekla were the kebeles in Dawa chefa wereda. Information was delivered to DAs' of individual kebeles about the project, the required number of participants and the procedures planned to be followed. As a point of priority, arrangement was made to meet the farmers in the selected kebeles of the three weredas. The farmers were briefed about the objective of the project and their obligation to participate in the project. Based on their interest the required numbers of farmers were selected. In some kebeles interested farmers were more than the required while in other kebeles farmers were few in number to meet the required number. In this regard the number of farmers was different from kebele to kebele. Yeju was distributed only in Kobo kebeles to take the advantage that it can mature 15 days earlier than Teshal to combat the chronic low moisture stress. Teshal was distributed in Habru and Dawa Chefa kebels as they acquire better precipitation than Kobo. Hormat was disseminated in the three weredas as per their requirements. Based on the land size of individual farmers, good quality seed was prepared for every farmer. The seeds were distributed before June 27, 2007 in accordance with the signed memorandum of understanding. About 3 quintals of Hormat, 2.5 quintals of Yeju and 2.75 quintals of Teshal were distributed to the farmers. About 65 hectares were covered by the improved sorghum varieties in 2007. A field day was arranged on October 19, 2007 at Kobo as a means of evaluation and the

farmers' reaction was very encouraging explaining that the varieties were suitable to their farming systems in different aspects. At present almost all farmers have harvested and stacked the sorghum. Some farmers have threshed and verified the yield advantage over the local variety. The farmers said that the improved varieties were invariably better in yield than the local varieties. Some farmers have said that about twenty neighboring farmers have requested to change the seed of the improved sorghum varieties by tef. All farmers have registered at least another five farmers to convey seeds enough for half to one hectare farmland.

6 Short Term Technical Assistance (STTA)

This is a program whereby some key persons from the CRSP universities provide assistances on a short-term basis for solving crucial problems of the partner institutions of ANRS. A number of experts from VT as well as VSU have taken part as could be discerned from the following pictures.

Fig.22 Dr. Mike Bertelsen by regularly visiting the project sites and centers, has been providing constructive technical inputs for more sound lab and field works

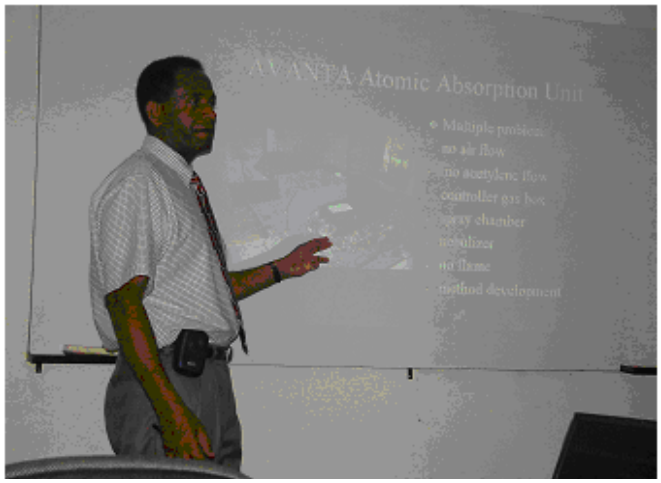


Fig.23 Dr Asmare Atalay, VSU, visited ARARI and its centers twice (2005 and 2007). His contributions on lab instrumentation, management and analyses were enormous. Furthermore, he has served also as a mentor of one of the SGMP projects.

Fig.24 Dr Anwar Hamama, VSU also visited ARARI and BDU during 23 July-4 Aug 2007 and provided assistance on tissue analyses and laboratory management.

Fig.25 Dr Bobby Grisso, VT visited Agricultural Mechanization Research Center of ARARI and made a lot of contributions in training the staff and providing expertise

Fig.26 Dr Dawit Haile, VSU visited ARARI and BDU (28 June – 10 July 2004 and 23 July – 3 August 2007) and offered trainings and assistance in data Management, Web Site development and library automation

7. Lessons learnt from the Research Component of AMAREW

- A substantial amount of achievement in a relatively short time was possible
- Need for different research strategies for different target areas (commodity or agro-ecology-based vs watershed-based)
- Most of the farming systems are in desperate need of access to options of agricultural technologies
- There are areas not yet addressed at all or adequately by the research system
- Participatory approaches for constraint identification, research planning, monitoring and evaluation entail faster technology development and transfer
- Provision of agricultural technology (ies) alone may not bring about desired changes in livelihood in most of the target areas; changes in attitude, culture, psychology, and other social aspects have to be readily addressed
- Technologies linked to markets are adopted faster

8. Conclusions and perspective suggestions

Since the beginning of the AMAREW Project, around 300 research experiments and related activities of different categories have been conducted by the five research centers of ARARI with the support of the project in a bid to avail agricultural technologies that that would enhance food security situations of their mandate woredas. From out of these, a total of 151 technological recommendations were developed primarily for the target groups in the pilot woredas and beyond. Thirteen of these recommendations represent those, which were made on natural resources 12 on livestock and 124 on improved varieties and production packages of cereals, pulses, oilseeds, vegetables, and fiber crops.

In order to make best use of some of these technologies in a sustainable manner and also along therewith to establish their merits in larger scales, a scaling up program has been launched during 2007. The scaling up activities are envisaged to lay a foundation for strengthening the informal seed sector as an alternative scheme of improved seed source which at present is the major bottleneck of increased production and productivity in the country in general and in the region in particular.

By way of empowering the community in the target woredas and watersheds, the research component has played a vital role in the establishment and strengthening the informal seed sector. The number of members of Seed Potato producers at Gumet watershed in Sekela has now reached 36. They are on the second season of production and up until now around 250 quintals of improved seeds of seven varieties of potato have been produced and stored in the communal DLS built with the support of AMAREW. Each member of the group may get 3000-3500 Birr from the sale of the seed. This is indeed a success taking into account the production potential of the area in general and its inaccessibility to market outlets. The growers have to be organized in smaller groups, be trained on how to jointly evaluate and make officially certify products and construct their own DLS individually. Each group has to then be linked to the market available in the region as well as outside the region as a source of certified potato seed. Once they are organized properly, they should also be linked with ware potato out growers (both in the watershed and outside the watershed) that will be used as major feeders to the upcoming Dehydration Plant.

Consistent to the objectives set at the beginning of the project, AMAREW has been doing a whole lot of things to bring about a change at all levels in the traditional linkage between research and extension. These include: facilitation and creation of various fora such as joint review, planning and evaluation of research and extension activities executed under the technical as well as financial support of the project; establishment of community-based research and extension platforms like FREGs and RETCs. As a result of continuous initiations made by the project to instill the very essence of a harmonized and synergistic linkage between major stakeholders, a great deal of stride has been made at grassroots levels. In order to influence officials at higher levels, the project is planning to hold a decisive workshop with all frontline stakeholders.

AMAREW was also engaged in implementing the Small Grants and Mentorship Program. The experiences gained especially by the investigators from the mentors coming from the CRSP universities in the USA were certainly invaluable. The linkages established between the host centers and the specific universities of the mentors are worth maintaining.

Having such impressive achievements at hand, however, there are still a lot of things that need immediate attention of the various stakeholders if these encouraging results have to continue bearing fruits. Some of the critical points of worth consideration, from the perspectives of the RA, are the following:

- Inadequate availability of basic seeds of most crops including the widely grown cereals and pulses has always been a major bottleneck both in the region and in

the country. An alternative approach to backstop the deficit following the scaling up should be to organize farmers who will specialize in production of improved seeds of the various crops so that they will eventually develop into seed producing firms.

- With potato production, the next move should be to properly organize both ware and seed potato producers and at the same time workout time schedules for producing appropriate varieties at the most suitable period since there are three distinct growing periods. The whole scheme should be layed out so that the system feeds each other.
- Once the seed system is established, it is essential to ensure its sustainability. Some of the elements of sustainability relevant to the RC include such points as ardently conducting studies on market links and requirements like maintaining high qualities of products that will enhance value chains. To this may be added aspects of tissue culture and rapid multiplication schemes for generating healthy planting materials, seed or grain quality labs and standards, better infrastructure especially roads, and the like.
- Research agenda and planning processes drafted for such areas as Sekota and East Belessa should particularly base the watershed approach.
- The positive attitudes and experiences accumulated over the last several years with respect to establishing and maintaining linkages between research-extension and farmer should be heightened even at a better momentum. The lessons learned indicate that personal relations and commitments for the realization of a strong linkage have a significant value. Research centers should give due considerations that the strong relations established by such personalities will not be dampened with time; and those who are not yet successful in that respect are expected to work harder towards the bright end.
- Because of continuous change of strategy and sites especially during the first two years of the project there is quite a large number of experiments and activities that still need some more years to gather data that will lead to a meaningful conclusion. Especially those experiments dealing with livestock and natural resources are of this category. Therefore, they have to be brought to completion and the results have to be presented in a well-documented form.
- Somewhere at the end of the project, it would appropriate to run impact assessment in order to determine if the project has really brought positive changes in the lives and livelihoods of the target community or beyond.

Extension Component

1. Introduction

The extension component of the AMAREW Project was initially designed to help strengthen the extension system of the ANRS in general and selected drought prone and food insecure Woreda Offices of Agriculture and Rural Development (WOARDs) in particular through two interactive and interdependent programs, training and dissemination of technology. Accordingly, the Extension Component (EC) of AMAREW has been devoting its efforts to build the human and institutional capacity of the Bureau of Agriculture and Rural Development (BoARD) and the selected WOARDs to effectively disseminate agricultural and environmental technology information to the rural households in the target areas. BoARD and its grassroots structures in the selected pilot woredas have been responsible for project work plan implementation, while AMAREW has been providing technical advice.

At the beginning of the project, 13 extension woredas were covered by the project, but in 2005 the number of extension pilot woredas was reduced to five, namely East Belessa, Lay Gayint, Sekota, Guba Lafto, and Tehuledere, and the number of focus kebeles per woreda was also reduced to three. The EC of AMAREW played a pivotal role in the project's effort in promoting functional integration of the principal institutions involved in technology and information dissemination. Although the extension approach of the project has coincided with that of the ANRS government, significant variations have been evident in that the project emphasized participatrory planning and implementation. In addition to regular extension activities in crop and livestock production, and natural resources development, the EC of AMAREW has been addressing cross-cutting themes such as gender, home science, and HIV/AIDS.

2. Implementation Strategies of the EC

Two interlinked strategies were devised to address the specific objective of the EC and these are:

- Promoting ***effective extension service*** through a collaborative effort of BoARD, WOARDs of pilot Woredas and the Project Office and

- Fostering ***linkage and integration of Research, Extension and Farmer*** in the course of planning, implementation, monitoring, and evaluation.

AMAREW's overall goal of contributing to the ANRS effort of improving the region's food security could be realized through bringing about paradigm shift in the current working relationships of all stakeholders, research, extension, and farmers. This means that the functional relationships in technology generation, transfer, and utilization have to be improved. For this to become a reality all primary stakeholders (researchers, extensionists, and farmers) should be actively engaged in ensuring functional linkage and integration of their joint activities.

Details of the accomplishments of the EC of AMAREW through each of the two strategies mentioned above and the outcomes realized during the five-year life span of the project are discussed below.

2.1 Promoting effective extension service

Different capacity building measures have been introduced and activities performed to improve the extension service capacity of BoARD and the pilot woredas and enhance the effectiveness of the extension service in the program area. The main ones are the following.

Addressing the logistic requirements of the pilot woredas has been an important consideration. In this regard, shortage of transportation facilities was one of the long-standing critical impediments to the healthy progress of the conventional extension service. In its attempt to improve the effectiveness of the extension service in its program areas, AMAREW provided a double cabin four-wheel drive field vehicle to each of its five pilot woredas.

A significant amount of financial contribution through annual budget has been made both to BoARD and the pilot woredas according to a jointly developed annual work plan. Budget formulation has been done in a participatory way involving all the major stakeholders. The budget support in general was operational costs, provision of technological inputs, training, and other project related activities.

Table 14: Budget allocation and utilization of the Extension Component, 2003-2007

Year	Project Budget in Birr		
	Allocated	Utilized	% Utilized
2003	2,594,600	1,556,760	60
2004	1,647,980	988,788	60
2005	1,543,624	1,080,536	70
2006	1,571,521	1,100,064	70
2007	1,561,349	624,539	40
Total	**8,919,074**	**5,350,689**	**60**

2.2 Human resource development activities

Both long and short term training have been covered for and by the EC. The long term activities are reported in the Training Component of this report.

Extensive short term training of Subject Mater Specialists (SMS), Development Agents (DAs) and Farmers have been conducted. The project has provided skill training to the woreda technical personnel, DAs and farmers on application of technological inputs under promotion by the project.

During the last five years a total of 53 types of training to WOARD SMS members, DAs and Farmers on skills associated with the application of technological packages promoted by the project were given. Out of these 16 were on crop production, 12 on livestock, 9 on natural resource development and 12 on extension and home science (Table 15 and Annex Table 8).

Table 15. Short term training performances of the extension component over 2003-2007

Major intervention component	Accomplishments by source of trainees								
	SMS			DAs			Farmers		
	Plan	Acht.	% Achv	Plan	Achv	% Achv	Plan	Achv	% Achv
Crop production	13	5	38.5	213	132	62.0	2969	1377	46.4
Livestock production	14	11	78.6	183	95	51.9	3379	1759	52.1
Natural resource development	3	0	0.0	99	106	107.1	1127	894	79.3
Extension and home science	112	11	9.8	311	280	90.0	1419	910	64.1
Total	142	27	14.1	806	613	73.9	8894	4940	55.5

Additionally, over 160 experts of BoARD and teachers in the ATVT colleges were trained in participatory adult learning/teaching methods. Also 25 home agents from BoARD and five pilot woredas were trained in HIV/AIDS, Gender, Family Planning and Nutrition, as a follow up of the training on Experimental Adult Learning Techniques.

Experience sharing tours: Over the last five years period the project has organized and implemented a wide range of experience sharing tours for SMS, DAs, and farmers. All in all 44 SMS members of WOARD, 27 DAs, and 134 farmers participated in the tours. As ***"seeing is believing"*** successful experiences gained on highland fruit production and different aspects of watershed development were

successfully replicated in the AMAREW's program areas. Details could be referred on the Table 15 bellow.

Table 16. Experience sharing tours organized for exposure to successful experiences

Year	Trainees by Source				Area Visited	Experience gained
	SMS	DAs	Farmer	Total		
2003/04	23	10	70	103	Akaki AI center, Debre zeit national vet laboratory, konso sandw conservation practice, Chencha highland fruit production	
2006	21	17	64	102	The Awra Amba society, Lencha Dima, Ayoub and watershed management sites in Guba lafto, Kobo and Mersa Woredas.	
Total	44	27	134	205		

3. Technical applications of the extension component of AMAREW

One of the operational procedure variations of the project compared to that of the conventional government extension service has been AMAREW's emphasis on participatory approaches. Persistent efforts were made by the project to enhance participation of the appropriate stakeholders at all stages of project activity. Participation has meaningful impact in determining the outcome of any development endeavor. Consequently the project has been encouraging participation of stakeholders of all partners involved in the implementation of the project's work plan.

Planning

A typical annual work plan of the EC was prepared through workshops held at strategic sites such as Sekota, Woldiya and Bahir Dar with the participation of researchers from the appropriate Research Centers, BoARD experts, WOARD extension personnel, farmers' representatives, and AMAREW project technical advisors. Community level appraisals aimed at exploring constraints and resources of the different homogeneous target groups, prioritizing problems, identifying solutions, assessing potentials and opportunities have annually been carried out by the WOARD extension personnel before hand and outcomes presented in the planning workshop as input for planning..

For example, the Lay Gayint, East Belesa, and Sekela woredas along with Adet Research Center were involved in the planning workshop organized at Bahir Dar. On the other hand, the Sekota, Guba Lafto and Tehuledere woredas along with the Sekota Dry Land and Sirinka Agricultural Research Centers participated in the planning workshop organized in Kobo.

The farmers' field days organized at each woreda for evaluation of demonstrations of RCs and technologies disseminated by extension during the preceding year

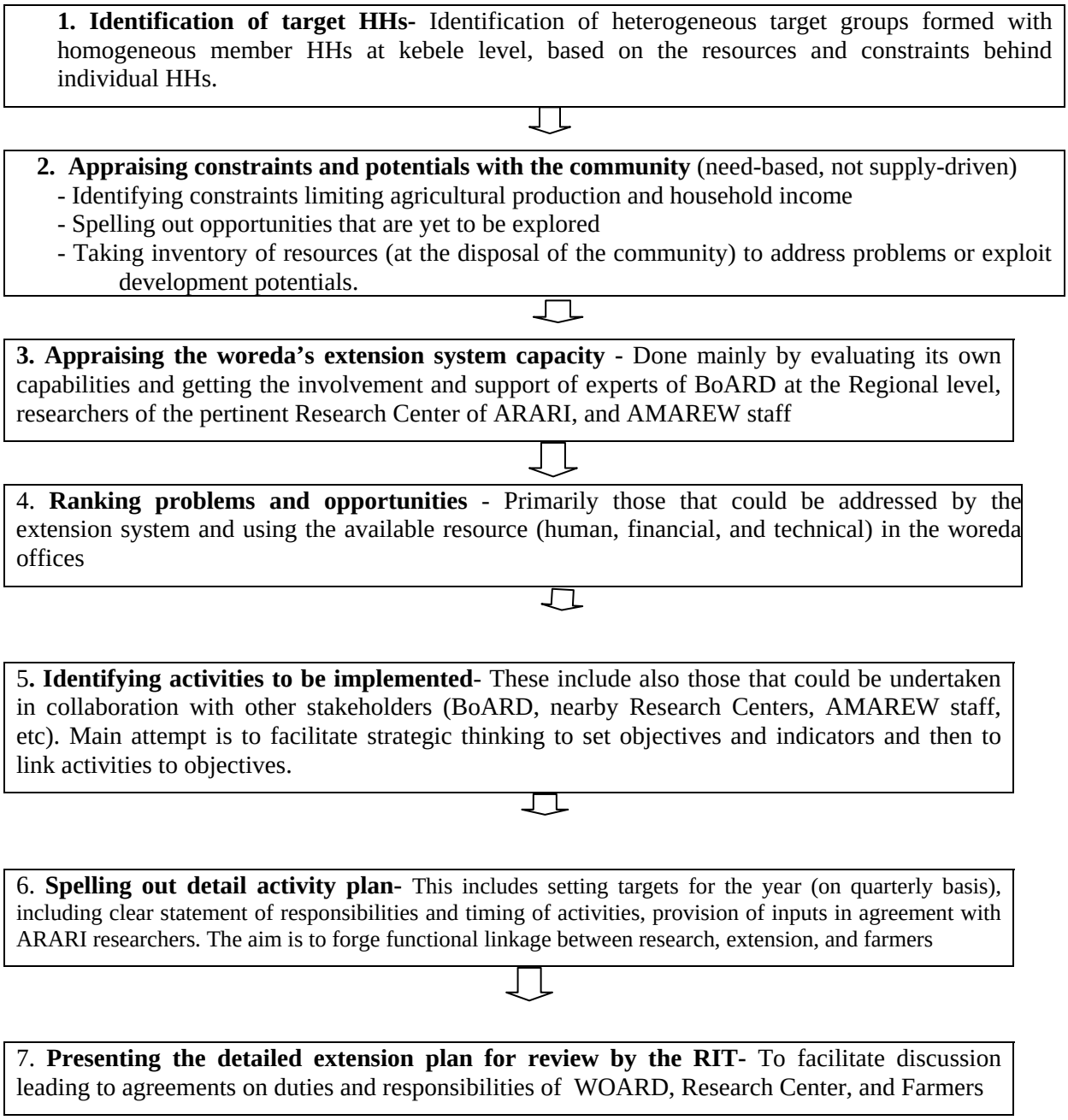
intervention, have enabled participants to generate valuable information that could serve as input in the planning exercise.

The planning exercise at each of the workshop venues often covered a period of two to three days, of which the first day was allocated for field day and reviewing the previous year's performance of the extension service in accomplishing targeted activities and outcomes realized. The second and third days were typically used for planning exercise.

The following figure shows the process that has been followed in planning the annual extension activities of all the pilot woredas.

Fig. 27. Annual joint review and planning workshops are usually supported with joint evaluation of on-farm demonstrations

Figure 28. The Planning Process of the Extension Component



4. Implementation progress

In view of achieving the overall objective of the project various intervention measures were planned and implemented with a principal emphasis of fostering dissemination of food, agricultural and environmental technologies in the extension woredas. Crosscutting themes such as gender, HIV/AIDS, home management and nutrition were also considered as comprehensive and integrated as possible in view of bringing about a substantial increase in agricultural production and household income of participating families.

Woreda Office of Agriculture and Rural Development (WOARD) has been the frontline entity responsible for implementation of the project's extension activities in all the pilot woredas of the project. The WOARD has generally been involved in the planning and implementation of on-farm trials, pre-extension demonstrations, Farmer-Research-Extension group activity and scaling-up of technologies. A focal person responsible for coordination of AMAREW project activities has been appointed at each pilot woreda. With the coordination of the focal person, implementation of project activities was facilitated by all concerned SMS personnel of WOARD and DAs working at the kebele level. The project office and the EC advisor have been providing technical advice for facilitating implementation of project activities including the planning exercise, training, conducting workshops, supporting WOARD's facilitation of procurement and purchasing of technological inputs, and monitoring and evaluation.

The EC of AMAREW made a major shift in planning and implementation of natural resource development activities beginning in 2006. AMAREW initiated small watershed activities in each of the three pilot woredas (Lay Gayint, Tehuledere, and East Belessa) which had no watershed based activities. The new intiative focused on a selected watershed in a project kebele in each woreda. The successful experiences gained from the previously established Lenche Dima and Yeku watershed management were the stimulants of this watershed based initiative. Experience sharing tours for the DAs and farmers from the new watersheds were organized which enabled them to visit and learn from the established watersheds.

Furthermore, since 2005, the EC has been engaged in strengthening the linkage and integration of research, extension and the farmer. Training on the formation and operation of Farmer-Research-Extension Group (FREG) has been given to a total of 98 technical staff members of the project's pilot woredas. A well-experienced freelance consultant from EIAR's Melkasa Research Center gave the training on FREG formation. Five FREGs have been established in AMAREW's focal kebeles of the two pilot woredas during 2006 following this training.

Two IPM/FFS groups have been organized in two extension kebeles of East Belessa in 2006 which were found to be a critical mechanism of empowering the community in managing crop protection problems.

5. Coordination of extension activities

For the extension intervention to be effective in leading towards increase in production and productivity, all relevant activities such as credit, skill training, technology, and input supply should be well coordinated.

Promotion of Credit: One of the critical impediments for farmers to adopt new technology appears to be shortage of money for purchase of technological packages. The EC of AMAREW initiated a revolving fund loan administration system to address the problem of fund shortage for the purchase of technological packages. The required money has been annually budgeted along with the project running costs of the pilot WOARDs. The specific loan is offered in kind to HHs adopters of specific technology identified in the project's annual work plan. Reimbursement was expected in kind soon after harvest in the case of crops, with variations in different types of technologies in duration and terms of reimbursement of loans. Reimbursement of those technologies with a relatively high costs and delayed return, such as drip irrigation equipment, modern bee hives and associated apiary technologies, and small ruminants supply often extended as long as two years. Reimbursements made by the initial adopter were offered to the second tier of adopters and the loan continues to revolve to subsequent adopters. Beneficiaries have directly participated and assisted the loan administering entities (WOARDs or Cooperatives) in managing and monitoring the administration of the revolving fund.

Skill training: Skill training is one of the critical extension activities determining the success of technology adoption. Depending on the degree to which a specific technology under promotion is compatible to the farming system of target HHs and also taking its complexity into account, skill training has been given to SMS members, DAs and target households on most of the technologies disseminated by the project. The skill training was essential to insure proper application of new technologies obtained from ARARI research centers or elsewhere. Performances of the extension component in accomplishing the target for training of SMS members, DAs and target households under the principal intervention components through 2003-2007 is presented in Table 17 bellow.

Table 17. Performances of the extension component through training over 2003-2007

No	Type of the training	Source of trainees	Year												
			2003		2004		2005		2006		2007		Total		
			P	A	P	A	P	A	P	A	P	A	P	A	% A.
I	Crop production	SMS	0	0	5	0	0	0	8	3	0	2	13	5	38.5
		Das	41	33	73	50	59	30	40	10	0	9	213	132	62.0
		Farmers	234	264	657	425	1044	192	710	178	324	318	2969	1377	46.4
II	Livestock	SMS	0	0	2	4	0	0	12	2	0	5	14	11	78.6
		Das	77	69	56	2	3	0	47	16	0	8	183	95	51.9
		Farmers	331	339	425	384	720	183	1372	513	531	340	3379	1759	52.1
III	Natural resource development	SMS	0	0	0	0	0	0	3	0	0	0	3	0	0.0
		DAs	78	84	0	22	0	0	21	0	0	0	99	106	107.1
		Farmers	333	374	130	269	185	60	381	144	98	47	1127	894	79.3
IV	Extension and home science	SMS	0	0	0	0	0	0	112	11	0	0	112	11	9.8
		DAs	211	177	0	63	15	12	89	28	0	0	315	280	88.9
		Farmers	565	547	80	168	25	0	749	195	0	0	1419	910	64.1
Total of the project		*SMS*	*0*	*0*	*7*	*4*	*0*	*0*	*135*	*16*	*0*	*7*	142	27	19.0
		DAs	*407*	*363*	*129*	*137*	*77*	*42*	*197*	*54*	*0*	*17*	810	613	75.7
		Farmers	*1463*	*1524*	*1292*	*1246*	*1974*	*435*	*3212*	*1030*	*953*	*705*	8894	4940	55.5

Table 18. Types of skill trainings conducted under major intervention components, 2003-2007

Crop production	Livestock Development	Natural Resource Development	Extension Skill and Home Science
Training DAs on application of crop production technological packages and extension methods	Poultry production	Soil and water conservation measures	Refreshment training on extension
Irrigation agronomy	Bee Keeping/General apiary/	Small scale irrigation development	Integrated extension package
Field crop production	Queen rearing method	Joint forest management	Extension system and package promotion
Crop protection (IPM/FFS)	Small ruminant management	Water harvesting techniques	Participatory research and extension (on FREG)
Coffee production	Artificial insemination	Irrigation development	Marketing of agricultural products
Horticultural crop production	Managing and feeding milk animals	Agro-forestry practices	Tailored need base training
Integrated crop management (ICM)	Selecting and feeding fattening animal	Energy saving stoves	Home management
Pest management	Hay-box brooder technology	Land use and administration regulations and policies.	Food habit and human nutrition
Improved grain storage	Livestock general	Compost preparation	Community organization Leadership training for action (COLTA)
Minimizing post harvest loses	Animal health care		Family planning
Moisture conservation and irrigation	Fishery development		Nutrition, food processing and preservation
Water harvesting and small scale irrigation	Forage production, strategic de-worming and feeding		Triticale processing
New tools and implements			HIV/AIDS prevention
Drip irrigation practice			Improved weaving
Tie ridging practice			Improved spinning
Insitue moisture harvesting			Improved pottery

6. Promotion of improved technologies

A large number of crop and livestock related technologies have been promoted through the revolving fund scheme of the project. Technologies related to natural resource development have focused on promotion of physical and biological conservation measures. Details of the technologies/information disseminated in the project's life time are presented on sector basis below.

Crop production: By and large the EC focus has been on major staple food crops, cereals and pulses. However, vegetable and fruit crops also have been considered to a limited extent. Improved and appropriate seeds/seedlings identified during the annual joint review and planning workshops by researchers, extension personnel, representative farmers, and AMAREW project staff have been mostly procured from the Adet Agricultural Research Center, Sirinka Agricultural Research Center, Sekota Dry-land Agricultural Research Center, Debre Zeit Agricultural Research Center, Melkassa agricultural Research Center, the Ethiopian Seed Enterprise (Bahir Dar, Assela, and Bale Branches), Awash Agro-industrial Enterprise, and the Chencha Highland Fruit Producers Cooperative.

Cereals

- Improved seeds of the major cereal crops which have been disseminated, according to their order of dominance, were wheat, tef, Triticale, maize, sorghum, fingure millet and barley.
- Seeds of 28 varieties out of the targeted 31 of the seven cereal crops were disseminated (Table 19 and Annex Tables 1-4).
- The total amount of improved seed of cereals disseminated was about 105 tons, which accounts for 91% of the target for the 2003-2007 period (Table 19 and Annex Tables 1-4).
- The number of households of AMAREW focus kebeles in the five pilot woredas receiving improved seeds of cereals was 5387 male and 823 female
- Productivity of the improved varieties with recommended agronomic packages has been significantly higher than the local variety with the traditional practice (Table 23).

Pulses

- In the order of the amount of seeds of the major pulse crops disseminated were faba bean, chick pea, haricot bean, and field pea.
- For a total of 1829 (1608 male and 221 female) target households, 50 tons of improved seed of these pulses has been disseminated.
- Productivity in general has been quite good (Table 23).

Potato

- Seeds of six improved varieties of potato have been disseminated to appropriate target woredas. The total quantity of seed was about 24 tons distributed to 250 male and 35 female HHs.
- Cuttings of different varieties of sweet potato, 1.5 million cuttings, have also been disseminated to 669 male and 141 female HHs.

Vegetables

- About 226 kgs seeds of different types of vegetables such as tomato, carrot, beet root, Swiss chard, lettuce, and cabbage have been disseminated to 3848 male and 980 female HHs.

Fruit tree seedlings

- A total of 38,710 seedlings of different types of fruit trees such as mango, avocado, papaya, apple, plum and pear, has been distributed to the project kebeles (Tables 19).

Table 19. Dissemination of improved seed through the EC over 2003-2007

Crop type	Physical				Targeted HHs			HHs who lost Production	
	Unit	Plan	Ach.	%	M	F	T	No	%
Cereals	Tone	115	104.8	91	5397	823	6220	564	9.1
Pulses	Tone	55.8	44.7	80	1608	221	1829	98	5.4
Vege.andfruit									
Potato	Tone	54.6	24.1	44	250	35	285		
Sw.potato cuttings'000'	No	672	1479	223	669	141	810		
Veg. Seed (Q)	Q	6.12	22.55	368	3848	980	4828		
Fruit seedlings no) '000'	No	22.4	38.7	173	NR	NR	NR	0	0
Total					11772	2200	13972	662	4.7

*NR represents Not Recorded.

Table 20. Improved varieties of crops disseminated through 2003-2007, and number beneficiaries per crop type

Crop	Physical				Targeted house holds			HHs with production failure	
		Plan	Ach.	% Ach.	M	F	Total	No	%
Tef	Q	204.6	259.9	127	2181	348	2529	75	3.0
Wheat	Q	649.8	663	102	2089	318	2407	396	16.5
Barley	Q	70	1.7	2	5	0	5	0	0.0
Sorghum	Q	51	28.5	56	499	56	555	60	10.8
Maize	Q	70.25	36.25	52	490	66	556	29	5.2
Triticale	Q	144	59	41	133	35	168	4	2.4
Total	**Q**	**1190**	**1048.35**	**91**	**5397**	**823**	**6220**	**564**	**9.1**
Faba bean	Q	207.1	272.3	131	887	109	996	69	6.9

Chick pea	Q	259	151	58	586	106	692	21	3.0
Haricot bean	Q	92	23.5	26	135	6	141	8	5.7
Total		**558.1**	**446.8**	**80**	**1608**	**221**	**1829**	**98**	**5.4**
Potato	Q	546	241	44	250	35	285	0	0.0
S. Potato Cuttings'000"	No	672	1497	223	669	141	810	0	0.0
Vegetables	Kg	612	2255	368	3848	980	4828	0	0.0
Total					**4767**	**1156**	**5923**	**0**	

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Livestock production: The efforts of the EC in livestock production focused on apiary and honey, poultry, small ruminants, and forage development. Improved technologies identified through the joint review and planning workshops of the pilot woredas, following the recommendations of researchers, extension personnel and farmers have usually been obtained from government ranches in the region and local market where the technology is available. Accordingly, improved poultry breeds have been accessed from the Andasa and Kombolcha. Improved local small ruminant stocks of Abergele goats and Washera sheep were obtained from the local markets of Abergele in Sekota Zone and West Gojam, respectively. Modern technologies such as hay-box brooder and different types of bee hives including other apiary equipment and different types of forage seed were also procured from local makets. Details of the performances on promotion of livestock technologies from 2003 to 2007 could be seen from Table 21 bellow and also from Annex Tables 5 and 6 for details.

Fig. 29 Livestock technologies which are successfully adopted by target HHs.

Table 21. Accomplishments in dissemination of livestock technologies, 2003 - 2007

Types of Technology	unit	Physical			Target HHs			HHs with failure in Prodn.	
		Plan	Achmt.	%achmt	Male	Female	Total	No	%
Poultry									
Day old chicks	No	26923	2500	9.3	43	20	63	21	33.3
Three months pullet	No	1260	140	11.1	11	3	14	1	7.1
Solomon hay box brooder	No	429	107	24.9	0	0	0	0	0.0
Apiary	No								
Transitional bee hive	No	390	200	51.3	160	5	165	0	0.0
Modern bee hive	No	270	279	103.3	225	54	279	27	9.7
Small Ruminant									
Washera sheep breed	No	1611	297	18.4	216	21	237	30	12.7
Abergele goat breed	No	485	623	128.5	73	32	105	0	0.0
Local goat breed restocking	No	420	100	23.8	13	12	25	0	0.0
Forage development									
Provision of forage seed	Q	244.34	116.4	47.6	336	181	517	0	0.0
Forage production	Km	248	377	152.0	0	0	0	0	
	Ha	257	144	56.0	0	0	0	0	
Total					1077	328	1405	79	5.6

Natural Resource Development: Dissemination of improved technologies/information under natural resource management has been largely concentrated on promotion of physical and biological conservation measures. During the early years of the project, appropriate physical and biological measures fitting the actual situation of AMAREW focus kebeles in the five pilot woredas were planned during the annual review and planning workshop with an active participation of researchers of ARARI, extension personnel of BoARD, community representatives and the AMAREW project staff. The project supported these activities in provision of materials such as hand tools and inputs. Tree seeds were normally provided and delivered by the WOARD in accordance with the work plan. In most cases, the project implemented physical and biological conservation measures on selected sites of community holdings using community mobilization (Table 22 and Annex Table 7). Since the beginning of 2006, the project shifted its natural resource development intervention to Lay Gayint, East Belessa and Tehuledere. The shift was necessary to develop mini-watershed management sites following the project's successful lessons from Yeku and Lencha Dima watersheds.

Table 22. Performances of the EC of the Project through natural resources development activities

Activities	Unit	Physical Year										
		2004		2005		2006		2007		Total		
		Plan	Ach.	Plan	Ach.	Plan	Ach.	Plan	Ach.	Plan	Ach.	%
I. Physical conservation measures												
Hill side terrace construction	Km	50	50	50	18	65	336					
Farm land terrace construction	Km	100	129	169	0	70	7.3					
Terrace Maintenance	Km	150	55	150	140							
Check dam construction	M3	1263	925	2330	108	3900	36065					
Bund stabilization	Km	150	0	150	0	235	100					
Gully rehabilitation	ha	2.5	5	5	5.2	15000	47462					
Trench construction	No	11000	0	30000	8389	0	0					
Small Scale Dam construction	M3	900	0	1300	0							
Micro basin	No	2000	0	24000	9500	5000	0					
Eye burrow basin	No	12000	0	10000	30000	13000	7750					
Improved pits	No	3000	0	0	0	4005	2					
Cut-off drains	M3	7650	0	0	0							
Hand dug well construction	No	400	0	0	0							
Trapezoidal water tanks	No	40	0	0	0							
Plastic bed water harvesting ponds	No	78	0	0	0							
II. Biological measures												
Compost preparation	Pits	390	0	40	0	4200	0					
Pitting and planting '000'	No	521	272	620	930	264	228.4					
Area closure	Ha	0	0	0	0	197	225					
III. Provisions												
Gabion Sac				1000	0	3000	2000					
Polyethylene tube	Q	11.75	13	58	50.3	7.5	5.2					
Multi Purpose Tree seeds	Kg	110	341	190	50	85	72.5					

7. Appropriate technology targeting and follow up

Heterogeneity is an inherent character of the rural community. Farmers differ in access to resource, age, education, sex, social status, and family size. Targeting should be considered not only on transfer of technology but also in technology generation and utilization. Appropriate technology should therefore be targeted to the appropriate target category identified with homogeneity among its members.

Due emphasis has been give to "Targeting of Appropriate Technology to the Appropriate Target category" by the EC to strengthen the extension service in the five pilot woredas. After all, the annual review and planning workshops were annually conducted with the active participation of community representatives selected in such a way that heterogeneity of the target community could be represented adequately. Interests of each homogeneous target category were therefore considered in the planning process. In the course of implementation also, selection of technology adopters was carried out on the basis of resources and constraints of the participating farmer. In such a way, targeting of appropriate technology to the appropriate target category has been practiced. For instance, improved poultry breed of white leghorn, home garden vegetable production, small ruminants production have mostly been targeted to women households. Improved varieties of cereals and pulses have generally been targeted to farmers having suitable plots, willing and/or able to fulfill all the input requirements of the package, and afford the labor required to undertake the necessary cultural practices. Access to water source has been considered as a main criterion in the selection of farmers for fruit tree adoption.

Technical support of the extension service sequentially goes through planning, implementation, monitoring, and evaluation. The EC of AMAREW has saved no effort in closely following up and monitoring the technology adopters so that timely corrective measures could be taken when necessary.

8. Monitoring and evaluation

The following activities highlight the monitoring and evaluation modalities used to follow up proper implementation of planned activities.

- The annual work plan was divided into quarterly action plan both at woreda and extension kebele levels specifying work flow, implementation time table, the responsible extension personnel and critical assumptions. A copy of the work plan was available at the development center, WOARD and AMAREW project office, serving as the principal monitoring document.
- WOARD assigned focal person of the AMAREW project, serving as the primary on-site coordinator of project activities implementation, prepares monthly and quarterly reports.
- Under the auspices of their respective desk heads, WOARD experts were expected to meet fortnightly to examine progress of project implementation.
- Deputy Head of WOARD convenes a monthly meeting of desk heads and the project focal person to assess progress of implementation of planned activities.

WOARD then delivers monthly and quarterly report to BoARD, FSPCDPO, and the AMAREW project office on progress of project implementation.

- WOARDs periodically and regularly submit all their financial documents to the finance department of the concerned institution (earlier to BoARD and in recent years to FSCDPO) and then the institutions submit financial reports to USAID/Ethiopia.
- Experts from BoARD and AMAREW project staff make frequent visits to follow up and provide technical assistance, especially in linking extension with research so that effectiveness of agricultural research and extension in the woreda is enhanced.
- The project normally conducts a mid-year review of project performance at the end of June or beginning of July as part of the monitoring exercise, with an active participation of woreda experts, DAs working in AMAREW focal kebeles and the extension advisor of AMAREW. Modifications on the annual work plan and the last two quarters would be introduced on the basis of the assessment made on accomplishments of the past two quarters. This practice enabled the project to facilitate efficient resource utilization.
- A community level appraisal followed by annual review and planning workshop was essential to critically examine performance of the year and plan for coming year. This exercise brought together all stakeholders, namely farmers, extension staff, researchers, and AMAREW project staff and local leaders. Both farmers' day and the review workshop gave ample opportunities for all stakeholders to express their views on project implementation progress.

9. Crosscutting themes

The EC has handled HIV/AIDS, Gender, and Home Science as crosscutting themes.

HIV/AIDS: Four of the five pilot woreds have organized training in the prevention of HIV/AIDS. This component involved medical experts from the concerned health offices. Besides contacts have been made with Family Health International (FHI) as to how the existing Anti-AIDS clubs in the five colleges and planned awareness creation activities of BoARD and the formation of Anti-AIDS clubs in many extension kebeles of the five pilot woredas could be assisted. Following this a number of Anti-HIV/AIDS school clubs have been established and supported in schools in extension kebeles of the four pilot woredas.

Gender: Every effort has been exerted to mainstream gender in all the intervention options devised by the extension component. Highest priority has been given for the involvement of women all through the planning, implementation and monitoring and evaluation process. Women have been involved in varying number in almost all the intervention options devised by the project, in such sectors as for instance, poultry, apiary, fuel saving stove, small ruminants, homestead vegetable development, modern spinning, weaving, etc. and all the trainings and support activities were targeted for women.

Home Science: The intervention through home science was initiated with the aim of addressing problems pertinent to dietary situation of the rural household and the

burdens on rural women. Trainings in family planning, home management, food habit and nutrition have been organized for four of the five pilot woredas during the early life span of the project.

10. Technical assistance.

The project office has been providing technical support to the WOARD of pilot woredas and BoARD in planning, implementation, monitoring and evaluation. The extension component has been supporting WOARDs and BoaRD in taking part on trainings, workshops and in many other areas as and when requested.

Support has been given to WOARDs of pilot woredas in coordination of procurement of technologies. The extension component has contributed on preparation of the PMP of the project in general and performance monitoring indicators of the component in particular. It has also organized important data of the component relating to performances, outcomes and experience gained.

Upon invitation the extension Associate/ Advisor attended and contributed in the workshops described hereunder.

- The national workshop on Ethiopian agricultural extension system, and presented a lead paper concerning the history and current status of agricultural extension in Ethiopia. He also introduced the efforts of AMAREW project to strengthen extension system in the ANRS.
- Serving as a member of the Regional Task Force to help the Livestock research Program better link with the Extension System and regional development Plans.
- Preparing course curricula for two departments of the faculty of Agriculture and Environment of Bahir Dar University.
- Providing advisory support to the task force established by the regional government to study the marketing system of the region.

Fig. 30 Exchanges of views on the implications of demonstrations by FREG members in progress

11. Fostering farmer, research, extension linkage and integration

Along with the effort which has been made to improve competence of the extension service in the pilot woredas, a considerable effort has been devoted by the extension component of AMAREW to enhance the functional linkage between Research, Farmers and extension. Different mechanisms have been devised and exercised to bring the functional linkage and integration of BoARD and ARARI both at the woreda and the regional level a reality. Some of the exercises are discussed as follows.

Joint review/preview and planning workshop

As it has been discussed earlier under strategy No.1 portion of this report, annual joint review and planning workshop, which has been organized to review performances of the preceding year and plan project activities for the following year has been evolving as a critical means of linkage and integration of research, extension and farmers through progress of the project lifespan.

During the later years of project implementation, annual review and planning workshop was exercised at the woreda level following a one day farmers' field day that emphasizes on evaluation of demonstrations. The workshop is conducted at each of the pilot woredas insuring an adequate representation of extension personnel, researchers from the relevant research center, Community representative (maintaining homogeneity), and experts of BoARD at Zonal and Regional level and AMAREW project staff. This specific mechanism of linkage and integration is found an appropriate arena of empowering farmers so as to influence the process and outcomes.

Joint implementation of on-farm trails and pre-extension demonstrations

On-farm trials and pre-extension demonstrations have been traditionally implemented by Research Centers' individual effort with a mere contact of researchers with the farmer. AMAREW however devised a means whereby these activities could be promoted with a joint effort of researchers, extension personnel at the woreda level and Development Agent of the area. This activity has appeared an area of interaction whereby the functional linkage and integration desired could be exercised in a more practical manner.

Promotion of Farmer-Research-Extension Group (FREG)

Farmer-Research-Extension Group (FREG) plays a pivotal role as a means of fostering linkage and integration of research, extension and farmers and serves as institutional set up promoting small farmer based seed multiplication scheme in the farming system. The extension component has been working on promotion of FREGs in the pilot woredas. Three FREGs (each having twenty five member households) which have been established in 2004 in the Lay Gayint woreda with a collaborative effort of the Adet Research Center and the WOARD have become examplary in brining researchers, extension personnel, and farmers effort together. On the basis of the experience gained on these FREGs, the component advanced to establish three FREGs in East Belesa Woreda and two in Tehuledere Woreda in 2006. These FREGs are encouragingly operating and the move towards further promotion has been on track.

Initiation of establishment of woreda level Research, Extension and Farmer Advisory Council (REFAC)

Efforts have been made to enhance the functional linkage between BoARD and ARARI at woreda level by proposing a memorandum of understanding between Woreda Office of Agriculture and Rural Development and the pertinent Research Center. A technical committee with defined duties and responsibilities has been proposed. The proposed modality was then accepted by both the WOARD and the respective research center and the committee established by some of the Woredas and research centers has already started operation.

12. Problems encountered

Problems pertinent to research, extension, and farmer linkage and integration

Efforts have been exerted by the project to bring functional linkage of research, extension and farmers at a pilot level so that it could be adopted by the Region for large scale intervention. The deep rooted traditional practice of executing development activities that relate to the working norms of both research and extension, is recognized as being critical impediment for the "shift in paradigm". Pilot level intervention that could be devised at grassroots level is in fact important to explore pertinent problems and influence concerned actors through practice. But, it should be supported with higher level policy concern. Therefore, it may call for, to the extent of, restructuring of the institution for agricultural

knowledge system and reformulation of duties and responsibilities of both research and extension personnel.

Centralized finance system
Single pool centralized finance system of pilot wordas which has been exercised at the mid-age of the project life span also has appeared an impediment against steady progress of project activities. Problems related to tradition of the bureaucracy, conflicting interest of individual actors involved, work load, etc. were found major bottlenecks on procurement and purchase of input and expending for local items and/or services.

Challenging situations/circumstances encountered
Lack of clarity on the overall direction of the project (restructuring and concentrating vs spreading) has been to some extent dragging the progress of project implementation. The issue of redesigning the project has in a way halted the 2004 planning process for months as we could not know which woredas would be beneficiaries of the extension component. Then following a short notice the component was required to come up with extension plan for six woredas. Then the plan so prepared had to be changed again as USAID/Ethiopia objected the newly proposed extension woreda. Unlike, the research component where research projects are planned and approved on a fixed time period, bottom up planning of extension activities requires time and also knowing the resources available to this effect. The attention of almost all classes of the society has been influenced by the national election which was carried out in 2005. Consequently, the concern of the frontline implementers and the target population for project activity has been diminished and there by retarded progress of project implementation.

High turn-over of staff
High staff turn-over experienced both at the project office and WOARD levels coupled with absence of submitting status or terminal report at WOARD has considerably hampered continuity of implementation of activities.

Inaccessibility of technology
Inaccessibility of technologies which in most cases is resulted from problems associated with technology multiplication, timely and adequate availability of inputs has appeared to be an impediment on the technology transfer activity of the component. The multiplication of improved technologies, such as, improved breeds of livestock, improved varieties of potato, cereals, pulses, etc. are areas that call for attention by the government.

Inconvenience encountered in fund release, utilization and reporting practice.
The difficulty to reconcile the budget liquidating and reporting practice of WOARDs with the fund release milestone laid by USAID/Ethiopia has been a critical obstruction on implementation of planned activities.

Limited knowledge base and experiences
The knowledge base to bring about a rapid and significant change on the “paradigm shift” attempted and thereby increase in production and income of the rural households in the food insecure woredas were challenging. The staff members of AMAREW, BoARD and

ARARI were working hard to expand the menu of options for extension. This requires generating adequate information on technologies both in the production and marketing aspect.

Attempt to overemphasize training
There is a widespread tendency to focus on training of DAs and farmers by woreda experts. There is a need to realize that training should be a vehicle for technology selection and dissemination and not an end by itself, if extension has to have a significant impact on household production and productivity.

Mindset of some experts and power structure
Though many experts were aware of participatory research and extension methods, experience in applying them practically was limited. Making farmers part of the decision making process in defining research and extension undertakings was oftentimes challenging to many experts. The mindset of many is such that they are deliverers of knowledge while farmers are learners seems to have wide spread. Besides, farmers tend to believe that there exists a power distance between themselves and experts.

Conflicting interest of actors resulting from deep rooted dependency syndrome
It is commonly recognized that a project is an arena of struggle whereby actors compete for scarce resources. This notion is promoted besides public interest. Nevertheless, coincidence of individual interest in most cases impinges the development process. The stand and reflections of actors all through planning, implementation, monitoring and evaluation appears to be requiring cautious follow up.

Inadequate communication and reporting
Information flows between the Regional Bureau, Project Office and WOARDs on one hand and between officials, experts and DAs on the other regarding the project and its objectives and modalities of operation were weaker. The technical backstopping of regional experts that could be made to woreda level experts has not been as much as expected. Beside the weak documentation system discussed earlier, woredas have been weak also in reporting technical and financial activities to The FSCDPO, Regional BoARD and the Project Office in a timely manner.

13. Effectiveness of the intervention through extension

Contribution of the extension component to the "paradigm shift" attempted

It is common to hear about the importance of research, extension and farmer linkages in the nutshell. One could simply be influenced by what one may hear over and over again without being pratically exposed to the situation under question. But there is no better way of decisively convincing as repeatedly practicing the exercise as is often said "*practice makes perfect*".

Researchers, extension personnel and farmers have been learning and building mutual trust out of their interactions during the processes of the annual review and planning workshops, implementing on-farm trials and pre-extension demonstrations,

establishments of FREG, etc. Each actor has been on the position to understand in the notion of promoting a human action with clear vision presumably leading to tangible results of public well being.

Therefore, the intervention has introduced change in the working tradition of actors involved, primarily farmers, researchers and extension workers. Certainly, the attitude of the stakeholders at present to work jointly is considerably high despite the difficulty encountered at the beginning to harness the various entities.

Improvement on production and productivity

Improvement on productivity of a number of cereal and pulse crops is realized as a result of dissemination of improve varieties (Table 23). As stipulated in the Table, increase in yield as much as two folds was realized on most staple food crops.

Table 23. Improvement realized on productivity through technologies disseminated

Crop	Productivity Q/ha	
	Local	Improved
Tef	6	11
Wheat	15	31
Sorghum	11	23
Maize	23	47
Faba bean	13	23
Chickpea	8	15
Haricot bean	9	22

Enhanced rate of adoption of horticultural crops

Although a wide range of crop cultivars is supposed to be adaptable in the Amhara Region, small holders farming practice is found highly dominated with cereals and pulses. Fruit and vegetable crops have been scarcely adopted in the farming practice of the rural households.

The high rate of adoption of fruit and vegetable crops by target households and households in the neighboring kebeles has significantly contributed to the improvement of dietary situation of beneficiaries and also to the improvement of the income of adopter households.




Fig. 31 Field views of technologies promoted through extension

Technology adopters

High rate of diffusion has been realized on the technologies disseminated.

- A total of 15,372 households (12,516 males and 2516 females) has been targeted for dissemination of crop and livestock improvement technologies ove 2003-2007.
- Significant rate of diffusion was recognized on a number of improved crop, Washera sheep stock and honey production technologies promoted.
- Large proportion of the community in the extension kebeles has been addressed with natural resource management technologies.
- Empowerment activities like establishment of FREGs, IPM/FFS, Anti-HIV/AIDS clubs, etc. have contributed a lot in alleviating problems affecting the livelihood of the rural household.

Changes Realized

- Target community's attitude towards productive technology has greatly improved.
- Food security status of the target population has improved.
- Asset base of the target households improved.
- Adopters were able to have access to diversified alternative source of income.
- Target households' access to social services has improved.
- A considerable number of households were able to improve housing from thatched roof to corrugated iron sheet.

14. Conclusions and recommendations

- In view of the Agriculture Led Industrial Development policy pursued with earnest endeavor of the Regional and Federal States for ensuring food security, the current extension program implementation capacity of the BoARD has to improve very much. Therefore, enhancing the existing extension program implementation capacity of the BoARD remains to be imperative.
- The extension service currently under promotion is found to be captive of a number of gaps and shortcomings. A number of these shortcomings and gaps have been identified and discussed in this report under the section "problems encountered". Since they are only briefly assessed and dealt with, it is strongly recommended that the gaps and shortcomings in the extension program of the region be thoroughly studied and remedial actions be devised.
- Increase in agricultural production and productivity of small holders remains to be one of the critical means of ensuring food security. This could be attained only through a well established technology generation, transfer and utilization system.

Watershed Management Component

1. Introduction

The Amhara micro enterprise development, agricultural research, extension and watershed management (AMAREW) project, since its beginning in July2002, has been conducting multi-faceted and integrated rural development activities in targeted woredas of selected pilot watersheds of the region in agricultural research, extension, watershed management and micro enterprise development. Under AMAREW's watershed management component, two pilot watersheds, Yeku in Sekota and Lenche Dima in Gubalafto, have been operational since 2003 and a third pilot watershed, Gumet in Sekela, was also initiated in August 2005.

The watershed management activities of AMAREW support research and extension objectives, and serve as the first level of integration for all project components. The underlying principle is to engage ARARI in testing a wide range of technologies at the watersheds and to provide the BoARD and other development organizations with land use planning tools and proven technologies for sustainable development and rehabilitation of arid and semi-arid areas in food insecure woredas of the region

Since its beginning the watershed management component has been operating as an integral part of the project's activities to fulfill the overall objectives of the project. In an internal impact assessment, relevant information from the watershed development activities implemented by each ANRS partner unit was obtained. The information obtained was consolidated to understand the impact that the component has brought in the livelihood of the target groups and beyond. Various compilation formats and indicators of impacts have been developed and used.

2. Objectives of the component

- To reduce the current level of land and water resource degradation caused by deforestation, overgrazing and soil erosion.
- To increase crop production by using *in-situ* soil moisture conservation, better performing varieties with improved practices and integrated pest management approaches.
- To reduce the current shortage of fuel wood, fodder, construction material and farm implements.
- To increase livestock production and productivity.
- To establish effective credit system for input supply.
- To test alternative approaches.
- To improve over all income and attaining food security at watershed level.

3. Expected outcomes

- Integrated watershed management planning and implementing capacity established within ANRS, using participatory methodologies, with BoARD leadership and broad institutional support.

- Replicable watershed management activities will be in operation at selected pilot sites, using participatory methodologies serving as learning center for watershed management implementation.
- Soil erosion minimized and better moisture conservation achieved.
- Fodder trees and shrubs introduced and forage and livestock productivity improved.
- Degraded hillsides regenerate and speed up environmental rehabilitation.
- Feed deficit improved and livestock disease incidence minimized.
- Crop and livestock production improved.
- Food security attained at watershed level.

4. Pilot watersheds descriptions, problems, and proposed interventions

The physical characterstics of the pilot watersheds and the interventions thought to be appropriate for the respective watersheds are presented in Tables 23 and 24.

Table 24. Pilot watersheds descriptions

No	Characteristics	Pilot watershed		
		Yeku	**Lenche Dima**	**Gumet**
1	Location, - zone	Wag Himra	North Wollo	West Gojjam
	- Woreda	Sekota	Gubalafto	Sekela
	- Kebele	Woleh 06	Laste gerado	Awsa guder
2	Total area	582 ha	1546 ha	508 ha
3	Altitude range	2050-2360 masl	1520 –1890 masl	2500–29000masl
4	Average rain fall	800 mm.	667 mm.	1500 mm
5	Total population	730	3375	
6	No of households	210	865	249
7	Average land holding	0.75	0.75	1.25
8	Household Level of capital goods			
	➢ With pair of oxen	14%	23%	11%
	➢ With one draft animal	86%	86%	28%
	➢ With no draft animals			61%

Major problems of the pilot watersheds

- Moisture stress and frequent drought, scarcity of water both for humans and livestock,
- Low crop productivity owing to poor fertility, un seasonal rainfall, and high input cost, soil erosion,

- Deforestation resulting in shortage of wood for fuel, construction and farm implements,
- Crop pests and diseases,
- Shortage of livestock feed,
- Human and livestock health problems,
- Shortage of oxen, and
- Lack of cash and seed shortage.

Table 25. Proposed watershed interventions during the project period by sub sector

No	Activities by sub sectors	Watershed			
I	**Soil and water conservation /*land productivity improvement*/**	**Unit**	**Yeku**	**Lenche Dima**	**Gumet**
1	Grass strip	Km	32	142	67
2	Stone bund / stone faced soil bund/	"	107	6	44
3	Soil bund	"	-	74	82
4	Check dam construction	"	1.374	2.772	1
5	Hill side terrace	"	112.1	223	
6	Micro basin	No			50000
7	Trench	"	26.21	-	
8	Retention ditch	"	-	47	
9	Cut- off drain	"	2.3	8.2	3.4
10	Water ways	"	2.1	12	3.3
11	Sisal seedling planted	No	534000		
12	Retaining wall /gabion/	Km	-	2.5	0.3
13	Manuring		50 % of hh	50% of hh	
14	Crop rotation, contour plowing, shilshalo and inter cropping				
15	Farmer training	No	90	200	165
16	Dry Road construction				6.3
II	**Water harvesting**				
1	Hand dug well	N o			5
2	Diversion weir construction	"			1
III	**Forestry and agro forestry**				
1	Seedling production	No	625,000	2,177000	
2	Seedling planting	"	625,000	2,177000	
3	Area closure and enrichment planting	Ha	80	150	20.16
4	Alley cropping				39
5	Vegetated soil conservation measure	"	50	160	10

6	On farm trees protected and managed	“	200	800	
7	Agro forestry plantations	“	5		
8	Trees and shrubs planted on farms and in gullies	“	-	33	
IV	**Crop production**				
1	Introduction of improved early maturing crop varieties ➢ Sorghum/ maize/ ➢ Teff ➢ Wheat	Qt “ “ “	93 8 25 60	43 23 20 -	205 28 39 137
2	Introduction of vegetable seeds	Kg			180
3	Purchasing of oxen through credit	No	63	100	80
4	Fertilizer				
5	➢ DAP ➢ Urea	Qt “	100 50	100 50	335 270
6	Tie ridgers	No	39	44	
7	Row planter	“	39	44	
8	Improved storage structure	“	100	202	
9	Establishment of IPM	“	10	22	
10	Compost preparation	“			10
11	Training for farmers	No	205	702	200
V	**Livestock production**				
1	Goat/ sheep restocking	“	240	1400	150
2	Chicks	“	900	4200	300
3	Provision of langstroth bee hives	“	35	-	
4	Provision of forage seed ➢ Siratro seed ➢ Cowpeas ➢ Vera no and Rhoades seed ➢ Stylo seed ➢ Rhodes seed	Kg “ “ “ “ “	 4.8 675 12 - -	 _ _ _ 43.2 32.4	150
5	Provision of shovel and pick axes	No	100	400	
6	Provision of veterinary service				
7	Development of bull service station	No			1
8	Farmers training	“	270	900	

5. Achievements attained by the watershed development component

The acchiements secured by the Watershed Management componet of AMAREW over the life span of the Project in the different pilot watershes are given in Tables 26-28.

Table 26. Achievements at Lenche Dima pilot watershed, 2003 - 2007

No	Activities	Unit	2003		2004		2005		2006		2007		*Total*	
			Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved
I	**Soil and water conservation**													
1.	Area closure	**Ha**	10	10.5	75	70	75	70	75	113	200	205	435	468
2	Micro basin	**No**	10000	6560	12500	15115	-	-	5000	17940	25000	26700	52500	66315
3	Hillside terrace	**Km**	30	12.5	19	52.5		256	90	99.14	150	247	289	667
4	Hillside Trench	**No**	-	-	3000	4445	5300	2216	5000	9996	3000	10962	16300	27619
5	Bund construction	**Km**	30	7	-	-	-	-	-	-	-	-	30	7
6	Cutoff drain	**“**	4	3	-	-	-	-	-	-	-	-	4	3
7	Check dam construction / stone + gabion + sand bag/	**M^3**	1000	1500	1000	1300	525	439	1000	2835.6	3000	5020	6525	11096
8	Gully head treatment	**M^3**							170	120	170	25	340	145
9	Gully revegetation	**Ha**	5	3	1.5	1.5	1.75	1.75	2	2.7	2	2.5	12	11.45
10	Sowing of forage seed on closed area	**Ha**	-	-	-	-	-	-	-	35	50	30	50	80
11	Seedling planting		70000	38600	150000	72000	200,000	79,120	150,000	150,000	175000	56410	745000	396130
12	Feeder road construction	**Km**					7	2.4					7	2.4
13	Gabion wire box production	**No**			15	41	-	57	-	28	50	50	65	176
II	**Water harvesting and supply**													
1	Dome construction	**No**			5	5	10	11	5	4	4	1	24	21
2	Pond maintenance	**“**			3	3			-	-	-	-	3	3
3	Construction of water point	**“**			1	1	**2**	**2**	2	2	-	-	5	5
4	Pump house Construction	**“**			-	-	-	-	1	1	-	-	1	1
5	Water pipe lining	**M**	2,080	2,080	-	-	-	-	1200	1200	-	-		
III	**Crop production**													
1	Provision of improved variety of cereals and pulses /sorghum, teff, maize, haricot bean, and chick pea/	**Q**	-	-	29	35	18	18.5	17.00	27.00	24	12	88	92.5
2	Provision of vegetable seeds	**Kg**	-	-	-	-	12	-	10	9	7	5	29	14
3	Provision of fruit seedling	**No**	-	-	-	-	500	804	-	2507	100	450	3107	3761
4	Provision of sweet potato cutting	**No**	-	-	55550	25000	-	-	-	-	-	-	55550	25000

	Farm implement						-	-	-	-	-	-		
5	Shovel	**No**	-	-	100	100	-	-	-	-	-	-	100	100
6	Digging hoe	"	-	-	100	100	-	-	-	-	-	-	100	100
7	Rake	"	-	-	50	165	-	-	-	-	-	-	50	165
8	Watering can	"	-	-	50	50	-	-	-	-	-	-	50	50
	Tie rigger								32	32	-	-	32	32
	Pedal pump								5	5	-	-	5	5
	HH drip equipments	"							4	1	4	2	8	3
IV	**Livestock production**						-	-						
1	Forage seed distribution	Qt	7.8	7.8	15	1.2	15	8	2	2	2	2	41.5	21
2	Goat restocking (3,goats / HHs)	No	65 hh	94 hh	300	135	360	-*	80	156	-	-		630
3	Promotion of Brooder	"	-	-	65	31	-	-	-		-	-	65	31
4	Chicks distributed	No						-	2400	-			-	2400
V	**Land administration**													
1	Boundary demarcation	Ha					1400	1400						
2	Provision of temporarily land certificate	No					895	745					895	1400
	Rehabilitated hillside and gully distributed for 33+171+110 hh	Ha	-	-	30	25	-	-	50	85	200	37.5	280	147.5
VI	**Training and capacity building**													
1	- On community organization and leadership/ COLTA/	**No**	32	27	32	29	-	-	-	-	15	17	75	73
2	- On Improved stove and home improvement	"	10	10	280	210	60	30	30	30	-	-	380	280
3	- On live stockmagement/goat, poultry, apiculture/	"	105	131	149	90	-	-	135	25	-	25	389	271
4	Integrated pest management		49	48	-	-	-	-	-	-	24	24	73	72
5	Soil and water conservation		13	13	-	-	-	-			40	46	53	59
6	Fuel saving stove produced	"							-	88				88

Table 27. Achievements at Yeku pilot watershed, 2003 - 2007

No	Activities	Unit	2003		2004		2005		2006		2007		Total	
			Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved
I	**Soil and water conservation**													
1.	Area closure	**Ha**	10	12	28	28	60	30	50	30	-	-	148	100
2	Hillside terrace	**Km**	20	19	56	160	50	350	10	198	-	15	136	742
3	Hillside trench	**No**			32000	5700	30000	21000	-	12787	2000	1256	64000	40743
4	Micro / eyebrow / basin	**“**	1000	6968	10000	2500	30000	2020	-	-	2000	-	43000	11488
5	Check dam construction / stone + gabion /	**M^3**	500	400	225	1007	14953	3000	1922	721.5	3400	1397	21000	6525
6	Sediment storage dam / SSD/	**M^3**			72	96	400	280	-	854.5	2000	6336	2472	7566
7	Percolation pit	**No**					2000	500	500	1824	500	140	3000	2464
8	Bund construction		10	13.8	11	18.4	-	-	-	0.8	-	-	21	34
9	Bund maintenance				-	-	-	-	-	22	-	3		25
10	Zai pit	**No**			-	-	-	-	-	3119	-	-	-	3119
11	Seedling planting		60,000	18,271	-	-	70000	8599	30000	50,670	50000	40875	210000	118415
II	**Water harvesting and supply**								-					
1	Spring development	**No**	-	-			2	1	-	-	1	-	3	1
2	Hand dug well	**“**	-	-	50	1	10	3	-	2	10	14	70	20
3	Hemispherical pond	**“**			-	2	-	-	-	1	5	6	5	9
4	Trapezoidal pond				16	4	-	-	-	-	-	-	16	4
III	**Crop production**													
1	Provision of improved variety of cereals and pulses / teff, triticale, wheat, chick pea, and sorghum	**Qt**	-	-	34	11	47	61	10	25	23	19	114	116
2	Provision of vegetable seeds	**Kg**	-	-	-	500	26	32.2	8	-	-	-	26	558.2
3	Compost making	**M^3**	-	-	192	84	-	960	-	300	-	-	192	1344
4	Promotion of improved mango Seedling	**No**	-	-							400	400	400	400
	➢ Coffee	**“**									200	400	200	400
	➢ Papaya	**“**									300	200	300	200
	➢ Shallot	**“**									2 qt	20000		20,000
	Promotion of HH drip equipments										5	4	5	4
IV	**Livestock production**		**2003**		**2004**		**2005**		**2006**		**2007**		**Total**	
1	Forage seed distribution	Qt	-	-	6.5	16.33	7	4	23	-	2	**7**	15.7	27.33

2	Goat restocking and fattening	No	120	120	276	270	420	420	198	300 for 50hh	-	-	1014	1110
3	Bee colony purchasing	“	-	-	150	150	-	-	30	-	30	24	210	174
4	Promotion of KTB hive	“	-	-	120	60	-	-	-	-			120	60
5	Top bar purchasing	“	-	-	4200	1753	-	-	420	-			4620	1753
6	Chicks distributed	No	-	-	-	-	-	-	2400	-			-	-
7	Provision of tools for apiculture	Set	-	-	-	-	-	-	15	10	30	30	45	40
8	Provision of wax printer	No	-	-	-	-	-	-	2	1	2	2	4	3
	Provision of honey extractor										4	4		
9	Provision of wax	Kg	-	-	-	-	-	-	100	100	100	100	200	200
V	**Land administration**													
1	Provision of temporary land certificate	No	-	-	-	-	-	1927	-	-	-	-	-	1927
VI	**Training and capacity building**													
1	CWMT member Management and leadership/ COLTA/ training	No	32	32	-	-	-	-	-	-	-	-	32	32
2	Farmers training on moisture conservation, compost making, soil and water conservation		38	35	110	103	-	-	30	30	-	-	178	168
	- Training on farm implements - Drip irrigation equipments								5 9	5 9	-	-	5 9	5 9
3	Training on HIV/AIDS and family planning		27	27	-	-	-	-	-	500	-	-	27	27
4	Farmers training on improved stove and house management		22	23	-	-	-	-			-	-	22	23
5	Fuel saving stove produced		-	-	-	-	-	-	-	26	30	50	30	76
6	Farmers training on livestock management /poultry, fattening, beekeeping and forage/		99	104	64	136	-	-	-	-			163	240

Table 28. Achievements at Gumet pilot watershed, 2006 - 2007

No	Activities	Unit	2006		2007		Total	
			Target	Achieved	Target	Achieved	Target	Achieved
1.1	Area closure	Ha	75	12	-	-	**75**	**12**
1.2	Hillside tied terrace	Km	90	-	-	-	90	-
1.6	Gabion check dam	M^3	700	56	500	42	1200	98
1.7	Stone check dam (wooden in km)	M^3	1000	0.5 km	500	-	1500	0.5
1.9	Gully head treatment	"	-	-	6	2	6	2
1.10	Gully revegetation	Ha		1.5	6	2		2
1.11	Bund construction	Km	-	-	-	49		49
1.12	Bund maintenance	Ha	-	250	380	365	380	615
1.13	Tee lucern planting for bund stabilization	Km	-	150				150
1.14	Seedling production	No	-	65722	100,000	371,000	100,000	436,722
1.16	Pitting	No	80,000	65,722	44000	300,000	124,000	365722
1.17	Seedling planting	No	80,000	65,722	44,000	300,000	124,000	365722
1.18	Forage seedling planting	Kg	-	20	56,000	17,000	56000	17,000
1.19	Establishment of community nursery	No	1	1	-	-	1	1
1.21	Gabion box* / wire purchase	Kg	50	50 *			50	50
1.22	Feeder road maintenance	M	-	-	10	6	10	6
II	**Water harvesting and water supply works**							
2.1	Spring development	"	-	-	1	1	1	1
2.2	Hand-dug well	"	-	-	-	2	-	2
III	**Crop production component**							
3	**Introducing improved varieties of cereals and pulses**							
3.1	Triticale (minet)	**"**	15	45.5	40	16.20	55	56.20
3.2	High land maize-Kuleni andHora	Kg			-	20	-	20
3.3	Barley – HB42 andMisirach	Kg			1000	16	100	16
3.7	Provision of improved potato seed	Q	150	8	100	290	250	298
	Faba bean – Dagim	Kg	-	-	500	9	500	9
	Field pea	Kg			-	9		9
	Improved potato seed redistributed	"	82	82				
	Total income from sells of improved potato	Birr		14,800				
3.8	Provision of vegetable seeds	Kg	37	60	40	9.25	77	69.25
3.9	Provision of sweet potato cuttings	No	-	4750	-	-		4750

3.10	Promotion of temperate fruit seedlings - Apple - Peer - Plum	 “ “	 300	1054 454 100 500	650	600 480 120 -		10654
3.12	Promotion of farm implements ➢ Tieridger ➢ Pedal pump ➢ Armstrong plow ➢ Drip irrigation	 No “ Set	 5 5 5	 5 5 5	 - - - -	 - - - -		 5 5 5
IV	**Livestock component**							
4.1	**Goat and sheep restocking**							
4.1	Goat and sheep distributed	No	100	101 For 35hh			100	101
4.2	Bee keeping							
	- Promotion of modern beehive		-	29				29
	- Provision of transitional beehive	No	40	32			40	32
	-Provision of Top bar		1200	240			1200	240
	No of bee colony in transition bee hive	No			20	7	20	7
	No of bee colony in modern bee hive	“			15	12	15	12
	Promotion of wax printer	Qt			2	2	2	2
	Promotion of smokes and other accessories	Set			20	23	20	23

6. Major intervention results obtained

Community participation

In an integrated watershed management development tasks, it is vital that local farmers, users and beneficiaries play an active role. Their participation should start from the initial stage of problem identification and continue over subsequent stages of planning, implementation, monitoring and evaluation.

In all the three pilot watersheds of the AMAREW project community watershed management organization (CWMO) was established during the beginning of the project (Table 29). Each CWMO consists of 12-32 members including women, and are responsible for planning, implementing and monitoring the watershed development activity in their respective pilot watershed sites.

To strengthen the capacity of CWMO, additional leadership and management trainings were given to all members of the committee, some of the training contents included conflict management, consensus building, community organization and leadership skill and experience sharing tours.

In each pilot watershed AMAREW's participatory planning begins with understanding the community, the livelihood systems, and resource base. All watershed development interventions of the project were hence planned with the community, keeping in focus, their needs, constraints, and opportunities.

Fig.32 CWMO annual planning forum At Yeku watershed

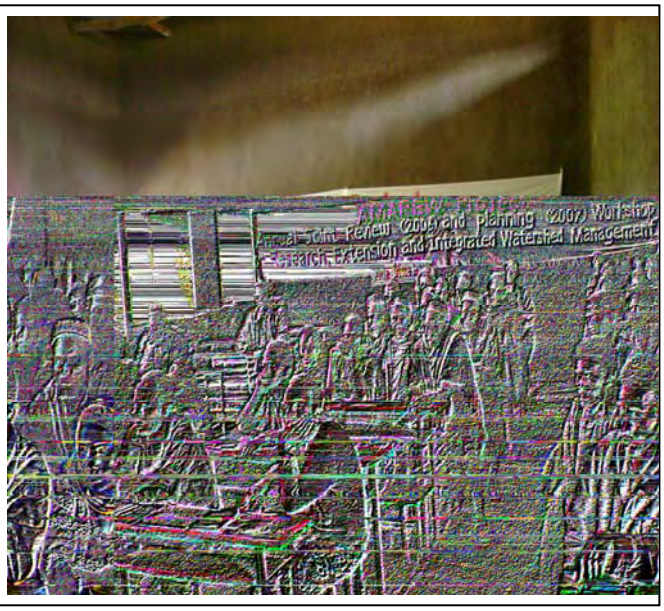

Fig.33 CWMO annual planning forum At Lenche Dima watershed

Table 29. Status of the CWMO established in the project watershed sites

S.No	Watershed	Year of establishment	No of CWMO members			No of gotes * represented by CWMO members
			Male	Female	Total	
1	Lenche Dima	2003	24	8	32	6
3	Yeku	2003	24	8	32	4
3	Gumet	2005	8	4	12	

* gotes are sub-Kebele Administrative units

7. Lessons gained

- Communities have high interest in development initiatives including rehabilitating natural resources, whereas government and donors should focus on creating an enabling environment, but refrain from directly being engaged in watershed management activities.
- Nothing should be given free as community members would feel owning and sustaining assets if and only if they pay for it:
- When people make real contributions of their own resource, they would insure the implementation of the planed activities.
- More emphasis has to be given to effective organization of communities rather than only focusing on introduction of technologies, the extent that communities are voluntarily organized to work together and take collective decision is an important of facet community participation in watershed development process.
- Capacity building interventions are necessary for community level initiatives. The aim should be to build the capacity of the community to manage their resources and to guarantee sustainability of what has been achieved through interventions of the watershed program.

Fig.34 CWMO annual planning forum at Gumet watershed

8. Major intervention results obtained at Lenche Dima watershed

Community based degraded land management

Degraded hillside management

Land degradation is a common problem in the ANRS in general and the pilot watershed of Lenche Dima is no exception. Water erosion, which is a serious problem in the pilot watersheds affecting productive agricultural land, is mainly caused by the heavy run-off from surrounding degraded hillsides. The pilot watersheds are also seasonally drought prone.

The most encouraging and sustainable results obtained are the natural resources conservation under community owned closed area management system where self-help user groups have been organized to manage degraded hillsides. Under this system, an area to be closed and managed was identified by the entire watershed community with the facilitation role of the Community Watershed Management Organization (CWMO). The community decided eligible users of closed areas to be landless individuals or those with small land holdings, often youths and women headed households. User groups, with a technical support from the woreda Environmental Protection Land Administration and Use and Authority (EPLAUA) desk experts developed their own bylaw. Once the bylaw was signed by members and a copy submitted to the farmers' administration and approved, the woreda EPLAUA desk could provide land use certificate to the user group.

In Lenche Dima watershed, since the initiation of the AMAREW project, a total of 473 ha of degraded hillside area was closed and extensive physical and biological conservation works have been carried out at about eight *gotes* of the watershed through food-for-work as well as free community labor mobilization. The physical conservation works include extensive hillside terracing, check dams using stone/gabion/sand bag, stone and soil bunds, eyebrow and micro-basins, trenches, and percolation ditches. The biological conservation works include multi-purpose tree seedling and forage seed planting over the trench constructed in the closed areas, and allowing local grasses to grow.

As a result of these physical measures, in addition to minimizing soil erosion, the closed area management at the pilot watershed has brought significant environmental impact. Farmers have started to observe that natural regeneration in the closure sites has allowed new shrubs and grass species, which were not present in the past. This is obviously the result of the soil seed bank regeneration capacity. Farmers have witnessed that more birds and a few wild animals are being attracted to the closure areas benefiting from the grass and tree growth serving as feed and shelter.

The other positive environmental impact is regulation and enrichment of stream flow. The extensive physical conservation works constructed by the communities in the closed areas have essentially curtailed the excessive run-off from the

surrounding hillsides. The main outcome has been increased infiltration and thereby improved the soil moisture. User groups have the privilege of harvesting grass under the cut-and-carry system. They indicated that the amount of grass each member harvests once is worth 300 birr at Lenche Dima due to the management scheme.

Fig.35 Trench on degraded hillside could easily control the run off and improve soil moisture for effective plant growth

Fig.36 Hay produced at the closed hill of Lenche Dima watershed

Fig.37 Lenche Dima serves as a learning center for sustainable land management and water harvesting structures constructed over the closed areas of Lenche Dima watershed

Fig.38 Hillside contour trench can control rainwater before it turns to runoff and percolate to the soil media

Table 30. Degraded hill side closure and rehabilitation activity result of Lenche Dima watershed

Name of the closed areas	Year	Closed Area in ha	Vegetation coverage status	SWC activities undertaken		Planted seedlings		New emerged plants and wildlife		Veg. Coverage status	Benefit gained
				Type	Amount	Type	Amount	Plant spp	Wildlife		
Bgido hill	2004	32.5	25 %	Hill side terrace, micro basin	15 km 5000	Acacia Eucalyptus	15000 10000	Sebensa,Enbis Amarisa,agam, kitkita wacho and grass	Kebero ,sesa and midaqua	75 %	- Reduced flood - Used as source of forage and generate income - Increased soil moisture - Reduce erosion - Being Shelter for wildlife -Rehabilitate environment
Oromo terara	2005	75	25 %	Hill side terrace Trench	24 km 450	Eucalyptus Olia Africana Acacia saligna	3000 3000 4500	Sebensa,Amarisa,agam,kitkita wacho and grass	Kebero sesa	50%	
Kolokobo “	2006	100	5 %	Hillside terrace Hill side trench Percolation trench Microbasin	148 km 513 1046 12940	Eucalyptus Pines radiata Acacia saligna Lusinea Spatodia Olia africana Acacia Pigeon pea	67828 13272 19847 8059 4044 3127 492 35 ha	Sebensa,Amarisa,agam,kitkita and wacho, kulqual,dedeho , and grass	Kebero sesa midaqua Hyena, tigrit	50%	
Dill amba	2007	15	25-30 %	- Hillside terrace - Contour trench - Micro basin - Stone checkdam - gabion check dam	150km 3000 25000 1200m^3 380 m^3						
Kille gora	“	30									
Kurt amba	“	50									
Aba holo Genda	“	20									
Jib wuha	“	45									
Layignaw Begide	“	25									
Kundi Terara	“	10									
Minchute	“	15									

Table 31. Beneficiary HHs from distributed closed and rehabilitated hillside areas of Lenche Dima watershed

Name of closed hills	Year	Area in ha	Location/Gote	Beneficiary farmers			Allocated land/individual In (timad)	Organized user groups	No of user groups members	Remark
				Male	Female	Total				
Minche Gora	2004	29	Kolokobo	36	8	44	2	1	44	Started to gain income
Bgido hill	2006	33	LencheDima	101	31	132	1	6	22	
KoloKobo hill	"	39	Kolokobo na Workiye	62	16	78	2	2	35 and 43	
Kolokobo	"	12.5	Adis Kebelena Wornio	16	7	23	2	1	23	
Workiye and kolokobo	"	13	Worke Gola	22	4	26	2	1	26	
Tit Kebele and Kolokobo	"	26	Titina Adis Kebele	40	12	52	2	1	52	
Dill Amba, Kille Gora Kurt Amba.etc.	2007		" "			110	2		110	
Total		**187**		**355**	**277**	**188**				

Table 32. List of beneficiary farmers receiving closed and rehabilitated hillside areas of Lenche Dima

No	Beneficiary farmers	Distributed year	Area in ha	No of planted seedling	Income gained			Income source
					2005	2006	2007	
1	Muleta Husen	2004	0.625	475	Forage	800		Hay sell
2	Mehamed ali	"	"	415	"	300		"
3	Sete Zeleke	"	"	396	150	200		"
4	Chane Goshiye	"	"	394	120	200		"
5	Seyid Tiku	"	"	412	"	250		"
6	Maritu Mola	"	"	236	80	120		"
7	Adise Fentaw	"	"	241	130	210		"
8	Mola Beyene	"	"	298	120	300		"
9	Asrese Belay	"	"	465	140	140		"
10	Ali husen	"	"	418	150	300		"
11	Yimam husen	"	"	413	Forage	300		"
12	Yasin Ahimed	"	"	719	"	300		"
13	Abebe Abera	"	"	391	120	300		"
14	Seyid Mehamed	"	"	393	150	300		"
15	Nuriya Belayi	"	"	415	100	300		"
16	Abebe Tsedaye	"	"	405	80	250		"
17	Mehamed Adis	"	"	382	Forage	150		"
18	Yimam	"	"	360	Forageand mat	Forage		"
19	Mengesha Ibrahim	"	"	490	Forage	200+ "		"
20	Mehamed yasin	"	"	411	"	250		"
21	Mehamed fenta	"	"	560	" and mat	200+mat		"
22	Seid Mola	"	"	412	150	350		"
23	Nuriye Mola	"	"	415	Hay mat	250		"
24	Jano mola	"	"	310	100	150		"
25	Mehamed mola	"	"	397	Forage	House mat		"
26	Seid hamlew	2004	0.625	542	"	300 birr		"
27	Seid Mola Tafachi	"	"	526	"	Forage+mat		"
28	Seid Yimam Kebede	"	"	504	"	" "		"
29	Endiris Mola	"	"	472	120 birr	260 birr		"
30	Sheh Husen Mohamd	"	"	511	Forage	350 birr		"
31	Seid Mulate	"	"	393	Forageandmat	260 "		"
32	Abdu Mulate	"	"	392	" "	240 "		"
33	Belay Desalegn	"	"	308	" "	200 "		"

Fig.39 Bunds on farmland are well treated in Lenche Dima watershed

Fig.40 Still more efforts are needed to treat and manage all ill treated sections of the watershed

Degraded gully management: Deforestation aggravates excess run-off and causes gully erosion on productive farmlands at the foot of hillsides of the pilot watersheds. Most farmlands at the foot of degraded hillsides are highly dissected with gully erosion. Increasing amount of extensive productive farmland is lost through gully erosion each year. With proper management, however, gully beds and sides could be converted into productive land for livestock feed, construction and fuel wood, and fruit tree production.

At Lenche Dima watershed, for the past five years, gullies were selected for rehabilitation demonstration purpose with a total gully length of above 6 km and extensive physical and biological conservation works have been carried out through food for work as well as free community labor mobilization. The physical conservation works include; loose stone check dam, gabion check dam, and sand bag check dam, including gully head treatment, and planting of multipurpose trees and shrubs seedlings at bottom and sides of gully. As the result of the intervention the reclaimed gullies become forage, fuel and construction wood source and reduce the ever-increasing productive land shortage in the watersheds.

Fig. 41 Rehabilitated gullies being properly managed and used for production of feed

Table 33. Results of gully rehabilitation activity of Lenche Dima watershed, 2004 - 2007

Gully and gully catchment location	Rehabilitation activity achievement								Type of Plant species grown in the gully	Benefit gained
	Activities	Unit	2004		2005		2006			
			Achieved	Area Dev.	Achieved	Area Dev.	Achieved	Area Dev.		
Minchegora And Kolokobo hills	Gully catchment's treatment at hillside	Ha		29 Ha		32 Ha		100 Ha		- Reduced flood - Used as source of forage and generate income - Increased soil moisture - Reduce erosion - Being Shelter for wildlife -Rehabilitate environment
	• Hillside terrace • Hillside trench • Percolation trench • Micro basins • Seedling planting	Km No " " "	15 - - 5000	" "	24 450		140 513 1046 12940	" 		
At the hill foot of Minchegora and kolokobo	Gully treatment			4 ha		-		3.5 ha		- Used as source of forage, fuel and construction wood - Generate income from sells of wood and grass -Protect road sides and farm plots from erosion - Increase productive land
	- Gabion check dam - Loose stone check dam - Sand bag check dam - Gully revegetation	M^3 M^3 M^3 Ha	350 200 750 4		200 239		286 2500 4		Sesbania, acacia saligna, elephant grass, lacuna, vetiver, sisal, eucalyptus and local grasses	

Water resource management and development at Lenche Dima watershed

Water supply and development

One of the major problems in Lenche Dima watershed is the shortage of clean water for humans and livestock. Community of Lenche Dima watershed has identified water shortage as a primary constraint and first priority for the integrated watershed development effort in their watershed.

The accessed domestic and livestock water source include gully sand bed holes, and community earthen ponds. Bad water quality and health concerns are the major problems associated with community ponds and gully sand beds. As most of these sources are seasonal, during the dry period women and children have to travel long distances in search of water. On the other hand, during the rainy season, most of the rivers and ponds are contaminated with floodwater becoming causes for other diseases.

To solve the water shortage problems with the support of AMAREW project the community has developed potential water source including six water points and reservoirs which were linked with pipe lines, pump has also been installed with pump house for the borehole. Labor and locally available construction materials such as sand, stone, gravel and water were provided by the community while the project provided materials that are not locally available. The constructed water system provides clean potable water for over 1200 households and meets the water needs of more than 600 livestock per day at Lenche Dima Watershed. The contribution of the developed water supply scheme in terms of reducing work loads for women and children and improving human and livestock health is highly rated and improves school enrolment of school-aged children.

Fig. 42 Community owned developed water point for human use at Lenche Dima watershed

Water harvesting and development

Moisture is also identified as a major problem for reliable and sufficient crop production. In line with the government's strategy direction in the construction of different water harvesting structures for supplementary irrigation at household level, very encouraging results are obtained in the pilot watershed sites. The selection of water harvesting structure types is based on farmers' evaluation on the climate, performance, management, cost and labor requirement factors. The dome shaped underground water harvesting structure is more preferred at Lenche Dima watershed. At present in Lenche Dima watershed 20 domes were constructed by 19 individual farmers of the watershed community and used to grow vegetables and fruit trees at their backyards and farm plots,

Fig. 43 Harvested dome water is being used by Ato Yasin to grow fruit trees and vegetables at Lenche Dima watershed

Fig.44 Ato Yasin has also started using drip irrigation to save and efficiently use the harvested water

Table 34. Summary of water harvesting and development interventions of Lenche Dima Watershed

Construction year	No of beneficiary	Type of structure	Achievement	Structure capacity	Cultivated land in m^2	Remark
2004	5	Dome	5	60 m^3	1250	Each individual cultivated more than 250 m^2, mainly planted fruit seedlings and vegetables
2005	11	"	11	" "	2750	
2006	4	"	4	" "	1000	
2007						
Total	**19**		**20**	**1200 *m^3***	**5000**	

Table 35. Project beneficiary farmers in water-harvesting structure in the Lenche Dima watershed

No	Farmers name	Type of Structure	Construction Year	Capacity in (m^3)	No	Plot area, m^2	Type of crop cultivated	Amount In No	Generated income	
									Consumed	Sold in birr
1	Ato Yasin Ahmed	Dome tank	2004 - 2006	60	2	600	Avocado, mango banana, papaya, orange, coffee, tomato and onion	228	√	355
2	" Wibetu Dagnaw	"	2004	"	1	250	Avocado, mango banana, papaya, chat orange, cassava and onion	86	√	205
3	" Abidu Sirage	"	2004	"	1	200	Avocado, mango, coffee papaya, orange,	36	√	
4	" Abidu Eshetu	"	2004	"	1	200	Avocado, mango, papaya, coffee, orange	28	√	42
5	" Yimam Ali Maria	"	2005	"	1	"	Avocado, mango, coffee banana, papaya, chat orange, tomato and onion	228	√	56
6	" Desalew Ali Maria	"	2005	"	1	"	Avocado, mango banana, papaya, chat orange, coffee	114		250
7	" Dessal Belete	"	2005	"	1	"	papaya, orange, coffee, chat, tomato, pepper, and onion	129	√	
8	" Mengesha Sisayi	"	2005	"	1	200	Orange	5		
9	" Melese Bayu	"	2005	"	1	300	Avocado, mango, coffee, papaya, orange, tomato and onion	90	√	
10	" Abate Nigusu	"	2005	"	1	200	papaya, avocado, mango orange, coffee, chat, , and onion	64	√	

11	“ Bekaris Mola	“	2005	“	1	200	Orange	15		
12	“ Adise Mola	“	2005	“	1	300	papaya, avocado, mango, orange, coffee, and tomato	31	√	
13	“ Fentaw Aligaz	“	2005	“	1	300	papaya, avocado, mango, orange, coffee, and vegetables	98	√	50
14	“ Mhamed Seyid	“	2005	“	1	200	Coffee, papaya, orange, avocado and mango	41		
15	“ Menigesha Yimam	“	2007	“	1	“	Coffee, papaya, avocado and vegetables	45	√	78
16	“ Abeba Arage	“	2006	“	1	“	Coffee and orange	17		
17	“ Nuruye Liben	“	2006	“	1	“	Coffee, papaya, avocado, and orange	20		

Livestock sub- sectors Intervention at Lenche Dima watershed

Goat restocking: At Lenche Dima Watershed restocking of goats was one of the major interventions, which was conducted through a revolving scheme for poor farmers of the watershed community.

A total of 735 goats were distributed for 194 watershed community members, out of which 136 are male and 58 female-headed households, who received a minimum of three and maximum of six goats per individual. Since 2003, 71 farmers were transferred the borrowed goats to the second level of beneficiaries and now those farmers are creating an asset for further goat production and satisfy the household need from selling of goats. Goat restocking is now considered as the major support of the project to the poor farmers of the watershed community.

Fig.45 Poor farmer households are being benefited in creating asset from distributed goats through revolving scheme. Goat restocking becomes successful interventions in the community of Lenche Dima watershed

In 2006, the number of second level household beneficiaries of goats from the revolving fund scheme reached a total of 71 (44 males and 27 females) each individual beneficiary receiving 3 goats per head which makes the total number of goats distributed to be 213. As of this particular year, none of these beneficiaries has given further the offspring of the goats he/she received to the next farmer

attached to him/her in accordance with the plan of the scheme worked out at the beginning.

Crop Production

Seeds are the most important input in all crop-based agriculture and prerequisite for the majority of the regional food production, they provide the basis for crop improvement. In moisture stress areas access to productive or propagation material for the coming season is increasingly difficult for small-scale farmers region wide.

One reason is the prevalence of pest and diseases, which together with decreasing soil fertility rate and moisture stress, leads to lower yield. The resulting food shortage make it difficult to save enough seed for the next season, this can have a negative effect on the local mechanism which replace lost planting materials, and can put seed supply at risk.

The project has a great focus on introducing and promotion of improved variety of cereals, crops, vegetable seeds and fruit seedlings, in Lenche Dima watersheds through revolving seed scheme, the community organized and establish a committee to control the revolving planting materials or seeds by establishing community seed bank at watershed level.

Table 36. Number of beneficiary HHs and goats given through a revolving scheme in Lenche Dima watershed

Year	Gote	Number of beneficiaries			Number of Goat / individual	Total goat	No of Reimbursed farmers
		Male	Female	Total			
2004	Gerado	4	1	5	3	15	All transferred to 2nd level beneficiaries
"	Lenchedima	7	2	9	3	27	" " " " " "
"	Kolokobo	5	2	7	3	21	" " " " " "
"	Adis kebele	2	1	3	3	9	" " " " " "
"	Biye	6	2	8	3	24	" " " " " "
"	Werenew	3	1	4	3	12	" " " " " "
"	Workiye	1	2	3	3	9	" " " " " "
"	Debis	1	1	2	3	6	" " " " " "
"	Kile	-	2	2	3	6	" " " " " "
"	Oromo	11	5	16	3	48	" " " " " "
"	Sefedamba	5	-	5	3	15	" " " " " "
"	Dishke	1	-	1	3	3	" " " " " "
"	Eroge	2	1	3	3	9	" " " " " "
"	Archebo	-	2	2	3	6	" " " " " "
"	Abahologeda	2	-	2	3	6	" " " " " "
	Sub Total	**50**	**22**	**72**		**216**	
2005		22	3	25	6 (5 nanny + I buck goat)	150	Not yet
2006		20	6	26	6	156	" "
2007							
	Total	**92**	**31**	**123**		**522**	

Table 37. Beneficiary HHs of cereals improved varieties through revolving seed scheme, Lenche Dima watershed

Year	Variety of cereals	Amount in Q	No of beneficiaries	Distribution rate Kg/farmer	Planted area in ha	Total area cultivated	Avg. yield gained Q/ha	Previous avg. yield Q/ha	Remark
2004	**Teff** • DZ-01-196 • CR-37	 3 6	 37 80	 8 7.5	 0.5 0.25	 18.5 20	 4.25 -	 4 -	- Teff DZ-01-196 variety has got good acceptance by the farmers because of it early maturity and can escape from drought, - Its production has no significant difference from the local teff - If the rain is reliable Because of short size of the plant and low productivity farmers do not accept sorghum varieties
	Sorghum (yeju,meko, teshale,gobiye,abishirand birhan) 0.5 q each	3	74	5	0.33	24	3	3.25	
	Chick pea (mariye)	10	100	10	0.25	25			
2005	-	-	-	-	-	-			
2006	**Teff** (DZ-01-196)	8	100	8	0.5	50	4.25	4	
	Sorghum • Yeju • Meko	 3 4	 74 100	 5 4	 0.33 0.25	 24.4 25	 3	 3.25	
	Chick pea (mariye)	7	70	10	0.25	17.5			
2007	Sorghum- Yeju	1	24	5	0.25				
	Tef –DZ01-196	5	60	8	0.25				
	Maize - Katumani	2							

Users group organization and income generating scheme development

Gabion producers: Micro-enterprise developments through user group organization at Lenche Dima watershed include gabion wire box production. There is a high demand for gabion boxes in the woreda and its surroundings. The nearest source of gabion boxes is either Debre Tabor or Mekele with a cost of 350 birr per box. It is believed that the production of gabion boxes at Lenche Dima, in addition to raising incomes of poor farmers' group, will greatly reduce government and non-government institutions' time spent through long distance travel for the procurement of gabion boxes. The project arranged for the training of farmers and provided the initial materials for gabion production. Now the gabion production activity in the watershed is in full swing and operational.

Gabion producers at Lenche Dima watershed are presently contracted by the Woreda Office of Agriculture to produce for the various food security programs within the woreda and at zonal level. In economic terms, one gabion-producing farmer within a month can make cash income equivalent to his/her annual income from crop production. To assist farmers to devote all the necessary attention and time to their farming, gabion production is deliberately scheduled during the slack period of January-March

Fig.46 Gabion box producer farmers at Lenche Dima watershed

Table 38. Trained farmers and their income from gabion box production, Lenche Dima watershed

Year	No of trained farmers	User group members	Production and income gained		Working days per year
			Produced	Income	
2004	15	6	41	1230	20-30
2005	-	"	57	1710	"
2006	-	"	28	1120	"
2007	-	"	59	1850	"
	Total	6	185	5,910	

9. Major intervention results obtained at Yeku watershed

Community based degraded land management

Degraded hillside management: Land degradation is a crucial problem of Yeku watershed in Sekota woreda. Water erosion, which is a serious problem in the pilot watershed affecting productive agricultural land, is mainly caused by the heavy run-off from surrounding degraded hillsides. The pilot watersheds are also seasonally drought prone and afforestation programs have shown very low survival rate.

The most encouraging and sustainable results we obtained are from natural resources conservation under community owned closed area management system where self-help user groups have been organized to manage degraded hillsides. Under this system, an area to be closed and managed was identified by the entire watershed community with the facilitation role of the Community Watershed Management Organization (CWMO).

In Yeku watershed, since the initiations of the AMAREW project a total of 100 ha degraded hillside areas was closed and extensive physical and biological conservation works have been carried out through food-for-work as well as free community labor mobilization. The physical conservation works include extensive hillside terracing, check dams using stone/gabion, stone and soil bunds, eyebrow and micro-basins, trenches, sediment storage dams, and rock-fill dams.

Fig.47 Yeku community closed area management serves as learning center for woredas experts, DAs and farmers of the Wag Himra zone.

As a result of these, in addition to minimizing soil erosion, the closed area management in the pilot watershed has brought significant environmental impact. Farmers have started to observe that natural regeneration in the closure sites has allowed new emerging shrubs and grass species, which were not visible in the past. This is obviously the result of the soil seed bank regeneration capacity. Farmers have witnessed that more birds and a few wild animals are being attracted to the closure areas benefiting from the grass and tree growth serving as feed and shelter.

The other positive environmental impact is regulation and enrichment of stream flow. The extensive physical conservation works constructed by the communities in the closed areas have essentially curtailed the excessive run-off from the surrounding hillsides. The main outcome has been increased infiltration and thereby improved ground water recharge. User groups have the privilege of harvesting grass under the cut-and-carry system.

Fig.48 Restricting degraded areas from animal interference could easily facilitate rehabilitatione

Table 39. Degraded hill side closure and rehabilitation activity result of Yeku watershed in Sekota

Location of closed areas	Year	Area in ha	Vegetation coverage status	SWC activities undertaken		Planted seedlings		New emerged plants and wildlife		Veg. Coverage status	Remark
				Type	Amount	Type	Amount	Plant spp	Wildlife		
Adisan shimtah	2003	15	25%	- ***Hillside terrace*** - Micro basin - Check dam	19 km 6968 400 m^3	Eucalyptus, acacia saligna, Acacia decurence Pines radiata	18,271	Acacia, Kitkita, Dedeho, grasses	Midaqua, kok, Sesa, Aner,	85%	- Used as source of forage and generate income - Increased soil moisture - Reduce erosion - Being Shelter for wildlife -Rehabilitate environment
Tabtia	2004	25	30%	- Hillside terrace - Trench - Micro basin - Check dam	160 km 160 2500 1007m^3		-			75%	
Arkian	2005	30	30%	- Hill side trench - Trench - Check dam - Percolation pit	350 km 350 3000 m^3 500	Eucalyptus, acacia saligna, Acacia decurence Pines radiata	8,599			70%	
Adisan Abadigo	2006	30	35%	- Hill side terrace - Hillside trench - Percolation trench - Stone check dam - Gabion check dam - SS dam	198 km 12787 1824 1222m^3 700m^3 854 m^3	Acacia saligna “ Senegal, Chins mole Moringa Eucalyptus Olia africana, Pigeon pea,	50,670			60%	

Degraded gully management: Deforestation aggravates excess run-off and causes gully erosion on productive farmlands at the foot of hillsides of the pilot watersheds. Most farmlands at the foot of degraded hillsides are highly dissected with gully erosion. Increasing amount of extensive productive farmland is lost through gully erosion each year. With proper management, however, gully beds and sides could be converted into productive land for livestock feed, construction and fuel wood, and fruit tree production.

In Yeku pilot watershed gullies were selected for rehabilitation demonstration purpose and extensive physical and biological conservation works have been carried out through food for work as well as free community labor mobilization. The physical conservation works include; loose stone check dam, gabion check dam, and SS dam, including gully head treatment, and planting of multipurpose trees and shrubs seedlings at bottom and sides of gully. As the result of the intervention the reclaimed gullies become forage, fuel and construction wood source and reduce the ever-increasing productive land shortage in the watershed.

Fig.49 Gully rehabilitation works at Yeku watershed

Fig.50 Rehabilitated gully at Yeku watershed in Sekota woreda

Fig.51 SS dam serves as water harvesting and gully rehabilitation measure at Yeku watershed

Table 40. Results of gully rehabilitation activity of Yeku watershed, 2003 - 2007

Gully and gully catchment location	Rehabilitation Activity achievement							Benefit gained
	Activities	**Unit**	**2003**	**2004**	**2005**	**2006**	**2007**	
- Agamwuha - Kario sinun - Guda guudit - Arkia and Yeku	**Gully catchments treatment at hillside** • Hill side terraces • Contour trench • Percolation pits • Percolation trench • Seedling planted	 Km No “ “ “	 19 - - - 18271	 160 5700 - - -	 350 21000 500 - 8599	 198 12787 1824 50670	 15 1256 140 40875	- Reduced flood - Used as source of forage and generate income - Increased soil moisture - Reduce erosion - Being Shelter for wildlife - Rehabilitate environment - Replenish ground water and extend spring water flow
- Abdigo - Gudagudit - Yeku - Arkia	**Gully treatment** ➢ Stone/ Gabion check dam ➢ SS dam ➢ Rock fill dam ➢ Gully revegetation	 M^3 “	 400 -	 1007 96	 3000 280	 721 854	 1397 6336 2512	- Used as source of forage, fuel and construction wood - Generate income from sells of wood and grass - Protect road sides and farm plots from erosion - Increase productive land - Replenish ground water and extend spring water flow

Fig.52 Hillsides and adjacent farmlands are also treated and show result of maintaining of sufficient soil moisture

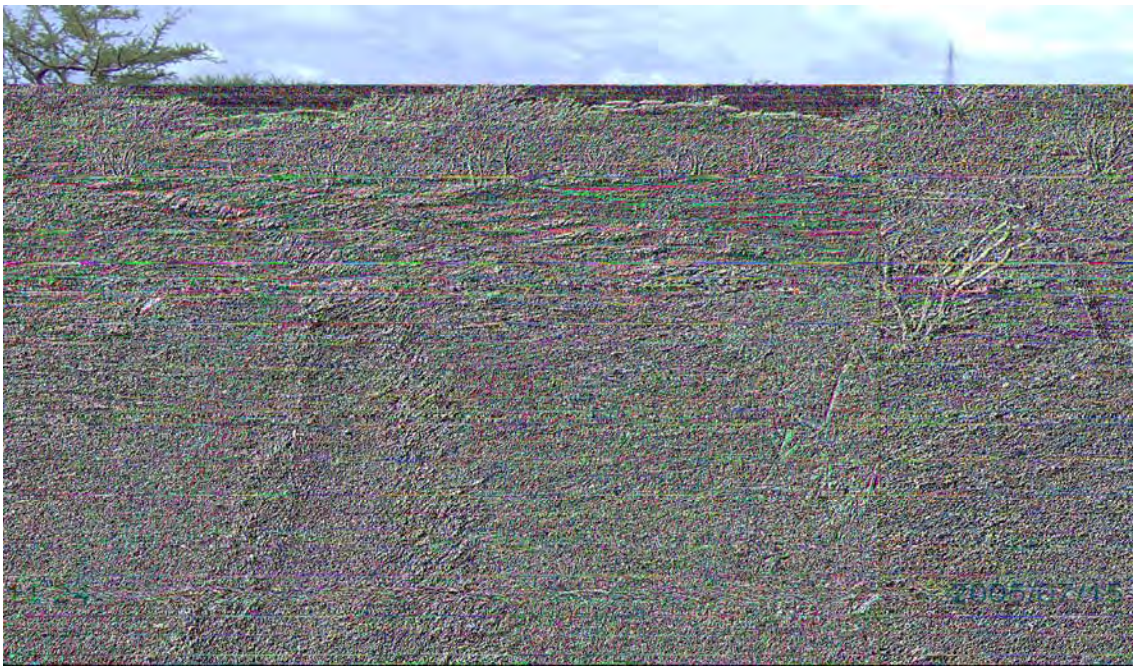

Fig.53 Trench on grazing land could sufficiently control the rainwater before it turns to run off

Water resource management and development

Water supply and development: One of the major problems in Yeku watershed is the shortage of clean water for humans and livestock. The watershed community has identified water shortage as the primary constraint and first priority for the integrated watershed development effort in the watershed.

The accessed domestic and livestock water source include gully sand bed holes, river, springs, and some hand dug shallow wells. Bad water quality and health concerns are the major problems associated with rivers and gully sand beds. As most of these sources are seasonal, during the dry period women and children had to travel long distances in search of water. On the other hand, during the rainy season, most of the springs and ponds are contaminated with floodwater becoming causes for many diseases.

To solve the water shortage problems with the support of AMAREW project potential water source were developed including spring and shallow hand dug wells in the watershed. Labor and locally available construction materials such as sand, stone, gravel and water were provided by the community while the project provided materials that are not locally available. The constructed water systems provide clean potable water for over 200 households and meet the water needs of more than 600 livestock per day at Yeku. The contribution of the developed water supply scheme in terms of reducing work loads on women and children and improving human and livestock health is highly rated and improves school enrolment of school-aged children.

Fig.54 AMAREW developed and community owned spring for human use at Yeku watershed

Fig.55 Water supply from a leach free spring for livestock at Yeku watershed

Water harvesting and development: Moisture is also identified as a major problem for reliable and sufficient crop production. In line with the government's strategy direction in the construction of different water harvesting structures for supplementary irrigation at household level, very encouraging results are obtained in the pilot watershed sites. The selection of water harvesting structure types is based on farmers' evaluation on the performance, management, cost and labor requirement factors. While the hand dug shallow well and hemispherical pond are more preferred at Yeku watershed. At present in both watersheds 9 hemispherical and 4 trapezoidal ponds and 17-hand dug shallow well were constructed and used to grow vegetables and fruit trees at their backyards and farm plots,

Fig.56 Night pond at Yeku watershed used for cattle and other household service

Table 41 Summery of water harvesting and development interventions of Yeku watershed

Construction year	No of beneficiary	Type of structure	Achievement	Structure capacity	Cultivated land in m^2	Remark
2004	7	- Hand dug well - Hemispherical pond - Trapezoidal pond	1 2 4	- 60 m^3 120 m^3	250 400 600	Hemispherical pond and hand dug well are the most appropriate water harvesting structures suitable for the area of Yeku watershed
2005	3 Community	- Hand dug well - Spring development	3 1	- -	750 For consumption	
2006	3	- Hand dug well - Hemispherical pond	2 1	- 60 m^3	400 200	
2007	16	- Hand dug well - Hemispherical pond	14 6	- 60 m^3	1200 1200	
Total			**30**		**5000**	

Table 42. Project beneficiary farmers constructed water-harvesting structures at Yeku watershed in Sekota

No	Farmers name	Type of Structure	No of WHS	Construction Year	Capacity in (m^3)	Plot area In (m^2)	Type of crop cultivated	No of fruit plant	Generated income	
									Consumed	Sold in birr
1	Wosen Tarekegn	- Hemispherical Pond - Shallow Well	2	2004 2005	60 -	200 “	Sugarcane, ginger, Papaya, Avocado, Coffee, and shallot,	345	☐	900
2	Abera Tareke	- Hemispherical Pond	1	2004	60	“	Papaya, avocado, Coffee, and pepper	40	☐	500
3	Getu Asemu	“	“	2005	“	150	Coffee, shallot, and pepper	14	☐	200
4	Desse Beyene	“	“	2003	“	200	Coffee, papaya, avocado, mango and shallot	50	☐	600
5	Kesete Biwota	“	“	2003	“	“	Avocado, papaya, and shallot	40	☐	350
6	Deribew Mekonen	“	“	2003	“	“	Papaya, avocado, and coffee	34	☐	456
7	Arega Beyene	“	“	2006	“	“	Avocado, papaya, shallot	25	☐	700
8	Tafete Tarekegn	“	“	2003	“	“	Papaya, avocado pepper	19	☐	100
9	Ageze W/ Atir	“	“	2005	“	15 0	Coffee, papaya, avocado, and shallot	21	☐	100
10	Tadese Adane	Trapezoidal pond	“	2004	120	250	- , avocado and shallot	12	☐	150
11	Chekole Sisayi	“	“	2004	“	200	Coffee, shallot	3	☐	50
12	Getamesayi Abera	“	“	2004	“	“	-	-		-
13	Gashaw Bezabih	“	“	2004	“	“	-	-		-
14	Tesema Mitiku	Shallow Well	“	2006	-	“	-	-		-
15	Mola Bere	“	“	2006	-	“	-, Avocado, cassava, shallot		☐	823

Fig.57 Ato Wosen, early adopter farmer at Yeku watershed had hemispherical pond and two hand dug wells and is using them for fruit and vegetables production, now his wife is harvesting papaya fruit at her backyard.

Fig.58 Upper catchment's treatment not only conserve soil and water it also replenish the ground water of the down stream catchment of the Yeku watershed

Livestock sub-sectors Intervention at Yeku watershed

Goat restocking: In the livestock sub sector restocking of goats is the major package intervention, which was conducted through a revolving scheme for poor farmers of the Yeku watershed community,

A total of 1243 goats were distributed for 222 watershed community members, out of which 47 are female houses holds, who had received a minimum of three and maximum of six goats per individual since 2003, 49 farmers were transferred the borrowed goats to the second level of beneficiaries and Now those farmers are creating an asset for further goat production and satisfied the house hold need from selling of goats. Goat restocking is now considered as the major support of the project to the poor farmers of the Yeku watershed community, especially, for women household.

Fig.59 Poor farmer households in Yeku watershed created asset through goat restocking using AMAREW project revolving scheme

Table 43. Number of beneficiary HHs and goats given through a revolving scheme at Yeku watershed in Sekota

Years	Gote	Number of beneficiaries			Number of Goat / hh	Total goat	No of Reimbursed farmers
		Male	Female	Total			
2003		16	4	20	6	120	17 farmers transferred to 2nd level of beneficiary
2004		25	11	36	6	216	32 farmers " " " " " "
2005				70	6	420	Not yet
2006		27	21	48	6	288	" "
2007							
Total						1044	

Second level goat beneficiary hhs from the revolving fund scheme

Years	Gote	Number of beneficiaries			Number of Goat / individual	Total goat	Remark
		Male	Female	Total			
2004		11	6	17	3-6	78	Received from 2003 first level beneficiary
2005		17	5	32	1-6	121	" " 2003 and 2004 1st level " "

Crop production intervention: Seeds are the most important input in all crop-based agriculture and prerequisite for the majority of the regional food production since they provide the basis for crop improvement. In moisture stress areas access to productive or propagation material for the coming season is increasingly difficult for small-scale farmers region wide.

One reason is the prevalence of pest and diseases, which together with decreasing soil fertility rate and moisture stress, leads to lower yield. The resulting food shortage make it difficult to save enough seed for the next season, this can have a negative effect on the local mechanism which replace lost planting materials, and can put seed supply at risk

Crop extension intervention in Yeku watershed include promotion of improved verity of crops and vegetable seed in a revolving seed scheme, strengthening of IPM/ FFS and promotion of fruit seedlings. Since the start of the AMAREW Project many farmers received improved seeds of different crop cultivars including tef, wheat, Triticale, and sorghum.

Due to un reliable rain fall, poor fertility and management practices the results of the improved varieties of crops introduced had little/no significant differences, fore example the average yield of the improved tef was about 8 q/ha which is a difference of only 1q/ha from the local, although under such harsh conditions big differences are not expected, it should still be possible to increase yield through on-farm demonstration of the recommended full package.

Table 44. Summary of beneficiary HHs in improved varieties of cereals, revolving seed scheme, Yeku watershed

Year	Variety of cereals	Amount in Q	No of beneficiaries	Distribution rate Kg/farmer	Planted area in ha	Total area cultivated	Avg. yield gained Q/ha	Previous avg. yield Q/ha	Remark
2004	Wheat HAR-1685	6.75	18	37.5	0.25	4.5	10	8	Little yield increment was observed at minimum management therefore, yield can be improved through improved agronomic practices and using full recommended package with close follow up and support
	Teff DZ-196	39.75	53	7.5	0.25	13.25	8	7	
2005	Wheat HAR-1685	4.125	11	37.5	0.25	2.75	8	6.75	
	Triticale mainet	1.5	7	20	0.25	1.75			
	Teff DZ-196	1	11	7.5	0.25	2.75	8	7	
	Teff CR- 37	1	12	7.5	0.25	3	4	4	
2006	Wheat HAR-1685	11.25	30	37.5	0.25	7.5	6.8	4	
	Teff CR- 37	4.5	18	7.5	0.25	4.5	6	5.2	
			20	15	0.5	10			
	Chick pea - mariye								
2007	Tef – CR-37	3	40	7.5	0.25	10			
	Wheat –HAR 1685	16	42	37.5	0.25	10.7			

Table 45. Beneficiary HHs in improved tef variety (CR-37), revolving seed scheme, Yeku watershed

No	Beneficiary farmers name	Year	Sex	Gote	Seed amount in kg	Planted area in ha	Current Yield in Q	Previous yield in Q	Remark
1	Adisu Selemon	2006	M	Adsan	15	0.5	2.5	2	Little yield increment was observed at minimum management therefore, it can be improved through improved agronomic practices and using of full package recommendations with close follow up and support
2	Chekole Legese		"	"	7.5	0.25	1.5	1.5	
3	Getu Mamo		"	"	"	"	1	0.75	
4	Asresu Bihonegh		"	"	"	"	1	1	
5	Abetir Fente		"	"	"	"	1	1	
6	Woyizer Gebiru		F	"	"	"	1.5	1	
7	Getwoyi Chane		M	"	"	"	0.5	0.75	
8	Melash Alemu		"	"	"	"	1.5	1	
9	Adissu Tesfayi		"	"	"	"	2	1.75	
10	Melesu Menegiste		F	"	15	0.5	1	1	
11	Selemon Alemu		M	"	"	"	1.5	1	
12	Yalew Wibete		"	"	"	"	2.5	1.5	
13	Azezew Mamo		"	"	"	"	1.75	2	
14	Mulu Mengiste		F	"	"	"	2.75	2	
15	Tafetu Negash		"	"	"	"	1.75	21	
16	Aregaw Asefa		M	"	"	"	1.5	1	
17	Werku Nigate		"	"	"	"	1	1	
18	Zerfu Maru		F	"	"	"	1.5	1	
19	Mamuye Demeke		M	Arkia	7.5	0.25	1	1	
20	Mesele Gebeyehu		"	"	"	"	2	2	
21	Adane Gebeyehu		"	"	"	"	1	1	
22	Muket Byene		"	"	"	"	1	0.5	
23	Arega Beyene		"	"	"	"	0.5	1	
24	Melese Wodaju		"	"	"	"	1	1.5	
25	Terfe Debash		"	"	"	"	1	1	
26	Adis Aderaw		"	"	"	"	2	1.5	
27	Baye Alemu		"	"	"	"	1	1	
28	Asmare Abebe		"	"	"	"	1.5	1.5	
29	Mseret Beyene		"	"	15	0.5	2.75	2	
30	Tigabu Kefle		"	"	"	"	2	2	
31	Lemlem Tareke		"	"	"	"	2	2	
32	Endalew Debash		F	"	"	"	2	1	

33	Shamble Belete		M	“	“	“	1.5	1.5	
34	Malefiya Tasew		“	“	“	“	2.5	2	
35	Kasa Belayi		“	“	“	“	2.5	2	
36	Dinku Debash		“	“	“	“	1	1	
37	Atena Beyene		“	“	“	“	2	1	
38	Tadese Adane		“	Tabto	7.5	0.25	1	1	

Table 46. Beneficiary HHs in improved wheat variety (HAR-1685), revolving seed scheme, Yeku watershed

No	Beneficiary farmers name	Year	Sex	Gote	Seed amount in kg	Planted area in ha	Current Yield in Q	Previous yield in Q
1	Aderaw Biyadgo	2006	M	Tabto	37.5	0.25	1	0.5
2	Adane Amare	"	"	"	"	"	1.5	1
3	Tadese Adane	"	"	"	"	"	2	1
4	Haile Mitiku	"	"	"	"	"	2	1
5	Getu Asemu	"	"	"	"	"	1.5	1
6	Adane Awoke	"	"	Arkia	"	"	1	0.75
7	Atena Beyene	"	"	"	"	"	1	0.75
8	Kesete Biweta	"	"	"	"	"	2	1.5
9	Mulat Gebeyehu	"	"	"	"	"	1	1
10	Deribew Mekonen	"	"	"	"	"	1.5	1
11	Asemare Abebe	"	"	"	"	"	1	1
12	Desalegn Aderaw	"	"	"	"	"	2	1.5
13	Moges Alemu	"	"	"	"	"	3	2
14	Shegaw Amoke	'	'	"	'	'	3	2
15	Arega Beyene	"	"	"	"	"	2	1
16	Desse Beyene	"	"	"	"	"	1	0.5
17	Ageze Wondatir	"	"	"	"	"	2	1
18	Alemu Mola	"	"	Adsan	"	"	1	1
19	Kasa Geryes	"	"	"	"	"	2	1
20	Wendimagegh Adane	"	"	"	"	"		
21	Melkamu Mola	"	"	"	"	"	1	0.75
22	Mulat Endalew	"	"	"	"	"	1	1
23	Kes Adane Zegeye	"	"	"	"	"	2	1
24	Abetir Fente	"	"	"	"	"	3	1
25	Zerihun Eniyew	"	"	"	"	"	3	1.5
26	Gashaw Bezabih	"	"	"	"	"	2	2
27	Birhanu Dinkayehu	"	"	"	"	"	1.5	1.5
28	Grmayi Mekonen	"	"	"	"	"	1.5	1
29	Girmayi Kemoke	"	"	"	"	"	2	1.5
30	Mulu Adis	"	F	"	"	"	2	1.75

Users group organization and income generating scheme development

Improved fuel saving stove: Improved stoves are possible to increase efficiency up to 50%, which can contribute to reduced deforestation significantly. More importantly, improved stoves burning wood in a closed area reduce smoke in the kitchen and its negative consequences upon the health of women and children.

At the Yeku watershed, ten women as a team were trained by the project on improved stove production in 2004.. The project initially provided these women with the necessary stove molds. The women contributed part of their own funds to start the stove production actively. They started the production of improved stoves with an initial capital of 500 Birr. Recently, the women group has raised their capital to over 7,000 Birr. Fuel saving stove production at Yeku watershed now not only helps the women group make money, it also contribute to reduction of deforestation. Shortage and fluctuating cement price and market are still major constraints, but this will not limit them to produce and they are now no longer jobless.

Fig.60 Yeku improved stove producers womens' group in Yeku watershed in Sekota

Fig.61 Yeku watershed community members are using improved stove

Table 47. Number of Organized women user group and income generated from producing energy saving stoves at Yeku watershed in Sekota woreda

Year	No of trained farmers	User group members	Production and income gained		Working days per year	Remark
			Produced	Income		
2004	10	7	50	2500	**20-30**	Most of the watershed community are using improved stove and now they are selling for other woredas and kebele households
2005	-	"	25	1250	"	
2006	-	"	24	700	"	
2007	-	"	40	2000	"	
Total	10	7	139	6450		

10. Major technology interventions result observed at Gumet Watershed in Sekela Woreda

Gumet watershed is located in Northwestern part of the Amhara Region, West Gojam Zone in Sekela Woreda. The watershed is characterized by undulating to hilly terrain and high rainfall and moderate temperature these result in severe land degradation through deforestation, soil erosion and over grazing.

In Gumet watershed since the beginning of the AMAREW project 40.5 quintals of Triticale, 90 quintals of improved seeds potato tubers and vegetables, and 1054 apple seedlings were introduced to members of the watershed community. In the livestock component 35 farmers were involved in sheep restocking package and promotion of forage. Different soil and water conservation activities were also carried out since 2006. The results of these interventions are reported as follows.

Fig.62 Farm land of Gumet watershed treated with graded terrace

Table 48. Summary of beneficiary HHs and improved varieties of cereals and horticultural crops distributed through revolving scheme at Gumet watershed in Sekela

Year	Variety of cereals	Amount in Q	No of beneficiaries			Seed distributed Kg/farmer	Planted area in ha	Total area cultivated in ha	Avg. yield gained Q/ha	Previous avg. yield Q/ha	Remark
			M	F	Total						
2006	Triticale	40.5	108	3	111	36	0.25	27			New for the area
2006	Improved potato	8	6	1	7	1 Q/ farmer	0.05	0.4	205		Average Income from sells of potato seed is 1,800 birr
2006	Vegetable seed	60 kg	303	163	466	0.13 gm	-	-			
2006	Temperate fruit seed ling (apples)	1056	69	11	80	13	$30m^2$	0.2	-	-	
2007	Improved potato	293	145	21	166	1 Q	0.05	10			
	Triticale	16.20			45	36	0.25				
	Barley-HB42	16kg	13			2kg					

Table 49. Beneficiary households and improved potato seed distributed through revolving scheme at Gumet watershed in 2006

No	Name	Sex	Seed distributed (Q)	Variety	Area Planted (ha)	Yield (Q)	Income gained
1	K/ Nebiyu Ayalew	M	2	Guwasa and jallene	0.1	9 10	3700
2	K/ Kokeb Bruh	"	1	Gera	0.05	9	1800
3	K/ Mezigebu Mihiret	"	1	Marachere	"	11	2200
4	M/t Bruh	"	1	Wochecha	"	12	1200
5	Ato Nebiyu Tibebu	"	1	Gorebela	"	14	1400
6	" Fekadu Mulu	"	1	Gera	"	11	2200
7	W/ Wibet kon	F	1	Zengena	"	12	2400
	Total				0.4	88	14,900

Fig. 63 W/ro Wubet Kon in her improved Gera potato plot

Fig.64 Vegetables and apple fruit seedling grow in Gumet watershed through irrigation

Table 50. Results of gully rehabilitation activity of Gumet watershed

Location	Rehabilitation Activity achievement				Type of Plant species grown in the gully	Benefit gained
	Activities	Unit	2006	2007		
			Achieved	Achieved		
- Lichma menged - Adey gerel	Stone and wooden Check dam Gabion check dam Forage seedling planting Tree seedling planting Grass seeding Gully revegetation	M^3 M^3 No “ Kg Ha	500 56 4000 1300 30 1.5		Bamboo, eucalyptus, tree lucern, vetiver grass,and sasbania	- Vegetation cover increased, Soil erosion minimized - Gully start to rehabilitate and made productive

Fig.65 Gully in Gumet before treatment One year after treatment

Fig.66 Multi purpose tree species like bamboo, eucalyptus and vetiver grass planted in the gully at Gumet watershed

Table 51. List of Beneficiary households and sheep given through revolving schemes at Gumet watershed in Sekela Woreda

No	Name of beneficiary	Sex	Gote	No sheep distributed	Born in 2007	Remark
1	Ato Amare Anilay	M	Guder	3	1	Distributed 2 females and 1 male sheep for each hh
2	" Zelalem Anilay	"	"	3	2	
3	K. Tafere Kasse	"	"	3	2	
4	" Worke Zelalem	"	"	3	1	
5	" Abebaw Alemneh	"	"	3	2	
6	" Mengistu Mekuanint	"	"	3	1	
7	" Kase Mengesha	"	"	3	1	
8	" Eshete Abebe	"	"	3	1	
9	k. Atinafu Lijalem	"	"	3	1	
10	" Liyih Lijalem	"	"	3	2	
11	" Gebeyaw Mulu	"	"	3	1	
12	" Chekile Bitaw	"	"	3	1	
13	" Woriku Asmare	"	"	3	-	
14	" Kasahun Alamirew	"	"	3	-	
15	" Mnigesha Ayalew	"	"	3	1	
16	" Alehign Aisheshim	"	"	3	1	
17	k. Gete Alene	"	"	3	-	
18	W/ro Mirte Alemu	F	"	3	2	
19	k. Belachew Kelemework	M	"	3	-	
20	K. Adissu Bogale	"	"	3	1	
21	" Wale Asifaw	"	"	3	2	
22	K. Anidualem Gela	"	"	3	1	
23	" Atalay Bitaw	"	"	3	2	
24	" Muse Guade	"	"	3	2	
25	" Ayichew wolela	"	"	3	2	
26	k. Kelemu Tibebu	"	"	3	1	
27	" Nigusse Teshager	"	"	3	1	
28	W/ro Eseyit Teshager	F	"	3	-	
29	" Gedamu Tadele	M	"	3	2	
30	" Tsegaye Muse	"	"	3	2	
31	" Admasu Belay	"	Sangib	3	1	
32	" Abiyu Workineh	"	"	3	-	
33	" Belachew Mkuanint	"	"	3	-	
34	" Geremew Belay	"	"	3	1	
35	" Tsegay Wudineh	"	"	3	2	
	Total		2	105		

11. Major Impacts Observed in the Pilot Watersheds

- The advisor of the component developed, in collaboration with other stakeholders, a community based participatory integrated watershed development guideline for national and regional level use.
- Hillside closure along with moisture harvesting structure speeded up environmental rehabilitation both at Yeku and Lenche Dima watersheds as a result of which seasonal spring flow duration extended by two or more months. Availability of ground water at a depth of eight meter hand dug well was also possible and the watershed community has also gained an average of 300 birr per year from selling of grasses from closed areas.
- Degraded gullies were made productive and used as source of feed and fuel wood.
- Water point development was top priority for both Yeku and Lenche Dima watershed communities which also solved the problem of shortage of clean water for human and livestock in all pilot watersheds.
- Soil moisture harvesting and gully rehabilitation structures constructed over the degraded hillside and farm lands maintained soil moisture for plant growth and assisted the replenishment of ground water and extended stream flow period at Yeku watershed.
- Many farmers from Yeku Watershed started producing vegetables and fruits through irrigation by harvested ground water by means of private hand dug well.
- Rain water harvesting by means of dome at Lenche Dima Watershed and hemispherical pond at Yeku watershed used for sustainable household fruit and vegetable production, which beyond arresting soil erosion has improved household income.Striga resistant sorghum varieties Gobiye and Abshir yielding high under the menace are now widely grown in farmer’s field of the Project site of Lenche Dima Watershed.The watershed community of the pilot watersheds ensured the availability of improved seeds of different crop varieties at household and community seed bank level.
- Poor farmer households of the pilot watersheds have created an asset through goat and sheep restocking using AMAREW project revolving scheme.
- Food-for-work approach in the pilot watershed of Yeku and Lenche Dima Watersheds was not only facilitating the upper catchment's land care activities, but also covers the watershed community food gap during the project years.
- Gabion box production at Lenche Dima and fuel saving stove production at Yeku watershed, not only helped the men and women group in generating additional income, but also contributed to the reduction of soil erosion and deforestation in both watersheds.
- AMAREW pilot watershed sites are now serving as learning center for DAs, woreda experts and farmers in the region.

12. Recommendations

In watershed management the most significant component to insure sustainable development is the community participation and empowerment. Community participation is the process of encouraging the local people to apply their initiative and energy to increase production and develop sustainable integrated watershed activities.
Establishment of community based watershed management organization is essential at the outset of the project or program.
The watershed communities could select their representatives at village or watershed level. Training on community organization and leadership for action and experience sharing tours would be arranged for the members of the watershed committee to encourage their commitment through learning from best practices of other watershed communities.
The committee could actively participate in problem identification, biophysical assessment, planning, implementation, monitoring and evolution of the watershed activities and achievements.

In the moisture stress areas of eastern part of the region, most of the undulating and hilly areas are highly degraded and left barren without soil cover as a result of deforestation, over grazing, age old farming practices and marginal land cultivation. These areas are currently considered as west land and only used for cattle stand; the upper catchment areas are currently encouraging soil erosion as being the source of runoff and initiate gully at the hill foot or the middle of the catchment. Hence for such rugged, undulating and hilly degraded landscape the appropriate land use practices are most likely to be degraded land rehabilitations, through community or group based closed area management in association with *in-situ* moisture or water harvesting (contour trench, eye borrow basin, infiltration pit, etc.) structures.

Multipurpose tree seedling and forage seed planting, gully revegetation and proper management and utilization are effective for efficient and immediate improvement of the environment. In areas like Sekota, which has shallow soil and poor performance of seedling survival, it is advisable to use seedlings from local or indigenous trees or direct seeding of local tree species over the closed and treated hillsides.

- Due to the runoff generated from the upper catchment gullies were formed and expanded towards farm and grazing lands, road sides and foot paths, these growing gullies had eroded the fertile portion of farm plots and grazing lands and thus changed into westland. Gullies are usually formed at the boundaries of individual farm holdings that are used as water way and also following foot paths over the farm and grazing lands. The threats are common in all parts of the region including both moisture stress as well as high rainfall areas.

Effective treatment and wise utilization of gullies are now considered as potential for agro forestry development in the region. The most effective gully rehabilitation practices learned from Yeku, Lenche Dima and Gumet watersheds are construction of *in-situ* moisture harvesting structures on gully catchments (contour trench, percolation trench or pit, micro basin, etc.), construction of check dams by locally available materials like stone check dam, gabion check dam, wooden check dam, sand bag check dam, and SS

dam are also integrated with gully revegetation by planting multi purpose tree and forage species and grasses on gully heads, beds and gully sides. If there is sufficient soil and moisture available in the rehabilitate gullies, planting fruit trees at the gully bottoms has even greater advantage.

The above mentioned land use practices have been demonstrated on the pilot watersheds and proved to have economic, social and environmental benefits for the community. These include:

- Farmers obtained fire and construction wood from the revegetated gully areas.
- Farmers also used gullies as source of forage and fruit plantation at Yeku watershed.
- Flood has been reduced, and further expansion of gullies was restricted.
- Runoff generating from marginal lands, hill sides, grazing lands and road sides has potential force to destroy the land and easily erode soils leading to gully formation. In such areas percolation trench/ditch, or infiltration pit is appropriate at the border of the farm land along the contour, this will help to manage and allow the soil to infiltrate the runoff vertically and horizontally. Through this process farm land soil moisture and ground water can be easily replenished. This practice can be applied especially in moisture stress areas, but in high rainfall areas cutoff drain with optimum gradient is recommended.
- Farm lands located in sloppy areas and undulating lands have to be treated in agreement with the farmer with appropriate land use practices, like, boundary contour terracing, stone and soil bunds, boundary live fencing, alley cropping, grass strip, etc.
- In moisture stress areas the priority problem of the watershed community is water, for crop, livestock and human consumption and domestic uses. Water is an essential element for living things to survive and for any kind of urban and rural development. Therefore, water harvesting intervention in these areas was the main focus of the project.

Water harvesting technology selection has to be done jointly together with users group from the watershed community. The community members could have the chance to visit some water harvesting demonstrations in order to have clear understanding on the different kinds of water harvesting structures, their benefits and efforts of farmers at the selected localities, on top of trainings provided locally.

Water harvesting technology can be selected, based on the watershed area, soil type and depth, climate, available construction materials, source of water, culture and need of the community.

- Experiences revealed that, for Sekota and similar areas, it can be advised that farmers use hemispherical rain water harvesting structure for plot level vegetable and fruit production and pond for livestock. If the watershed area is treated and managed well, ground water harvesting by means of hand dug well can also be recommended in association with percolation pit above the well where runoff concentration is common.

- For areas that have harsh climate (hot and dry temperature) like that of Kobo, and Lenche Dima, dome shaped under ground water harvesting is appropriate in combination with water saving technology like household level drip irrigation equipments for plot level vegetables and fruit production and pond is also useful for cattle.

Seeds are the most important prerequisite input in all crop-based agriculture and for the majority of the regional food production efforts as they provide the basis for crop improvement. In moisture stress areas access to seed or propagation material for the coming season is increasingly difficult for small-scale farmers in region.

The prevalence of pest and diseases, which together with decreasing soil fertility rate and moisture stress, leads to lower yield. The resulting food shortage make it difficult to save enough seed for the next season and this can have a negative effect on the local mechanism of seed saving and thus can put seed supply at risk.

The project, therefore, had put a considerable level of focus on introducing and promotion of improved varieties of cereals, pulses, vegetable seeds and fruit seedlings, especially in the dry areas through revolving seed scheme. The communities have been organized and established committees to control the revolving planting material or seed by establishing community seed bank at watershed level. This experience has grown at a level of establishment of improved seed potato producer group at Gumet watershed.

Training and FtF Component

1. Introduction

Through the different components of the AMAREW project, development and dissemination of new technologies that could be used in improving the production and productivity of crops and livestock, as well as managing the natural resources are planned to be implemented in strategically selected eight pilot food-insecure Woredas, five research centers, and three pilot watersheds. Obviously, for these new technologies to be adopted, people who are supposed to implement the technologies should have the required knowledge, skill and positive attitude. This includes people involved at all levels of the technology development and dissemination process. Woreda experts need to have knowledge and skill about the technologies that they are disseminating and about alternative methods of technology transfer. Similarly, researchers require knowledge that would help them to be effective and efficient in developing appropriate technologies. Furthermore, farmers who are the ultimate users of the technology should have clear understanding about the technologies and skills that would help them improve their practice. In addition, they also require knowledge and skill that will help them to commonly manage natural resources. On top of this, as a result of the decentralization process, the Woreda agricultural and rural development offices are made to shoulder the power and responsibility of deciding on all development activities that should be carried out in the Woredas without having the required manpower and capacity the job seeks which necessitates the execution of capacity building.

2. Strategies of human capacity building

Building the analytical, operational, and management capacity of partner institutions and farmers within the context of strengthened research and extension services were considered as key areas requiring the project support from the very beginning.

To this effect, the human capacity building activities were selected based on partners needs. The different human capacity building interventions targeted to convey knowledge, skill and creating positive attitude of the beneficiaries towards the introduced technologies or innovations in the areas of crop and livestock production, natural resource management and community organization and leadership. The ultimate intention is to strengthen the project's component based interventions in research, extension and watershed management. Mainly the approaches employed in human capacity building are geared towards the identification of long-term training, short-term in-service-training and educational or motivational study tour. In addition to this, Farmer –to-Farmer program, which is involved in the assignment of short-term volunteer technical assistances from USA, was used as complementary approach to build the capacity of professionals and farmers.

3. Achievements

In the last five years, the AMAREW project in partnership with ANRS institutions has conducted various capacity development activities and encouraging results have been obtained. Capacity building activities of the project have focused on long and short term

training, educational/motivational study tours, volunteer assisted technical trainings and other institutional capacity buildings like supply of office and field equipments.

Long-term degree training

MS degree: Table 52 reveals that a total of nine MS degree study opportunities were given to employees of the project's local partner institutions (BoARD, ARARI and EPLAUA) to obtain their degrees in two local universities (Haramaya and Mekelle). Out of the nine students who joined local universities, six of them have successfully completed their studies and come back to their respective places and they have already resumed their job (Table 53). The two others, namely: Binyam Desta Degaga from Debre-Birhan research centre and Tewodros Bimeraw Hilu from East Belessa office of Agriculture and Rural development, have not yet completed their studies. Regarding the current status of these students, thesis defense of Biniam Desta is extended until October 2007. Tewodros Bimeraw is in the stage of data analysis and write-up. Hence, both of them are expected to graduate on July 2008. Regarding financial matters, the only pending issue is that for student Binyam the office withheld Birr 4000 for advisor fee and thesis submission and for student Tewodros the office withheld Birr 1000 to be paid after the submission to the AMAREW project of the final and university approved version of the thesis. Referring to one student whose name is Demrew Wossenyeleh Gossa from Tehuledere office of Agriculture and Rural Development; he disappeared without leaving a note, after making use of project fund that amounted to Birr 27670 (twenty seven thousand six hundred seventy birr) and hence his completion date is long overdue.

BS degree: A total of twenty three BS degree study opportunities were given to employees of the project's local partner institutions (BoARD, ARARI and EPLAUA) to obtain their degrees in four local universities (Mekelle, Haramaya, Hawassa and BahirDar) in either regular or summer programs. Out of these students who joined local universities, ten of them have already completed their study (Table 53) while twelve of them are still studying and expected to complete in the range of 2008-2010 (Table 54) academic year. Referring to one student whose name is Tesfaye Setegne Zewdu from East Belessa office of Agriculture and Rural Development; he disappeared without trace, probably could not withstand the challenges of learning. When the long term trainings are disaggregated in terms of partner institutions, out of the total training opportunities given (32), BoARD took greater share 63% (Table 52).

Table 52. Beneficiaries of long term degree training disaggregated by partner institutions

Types of degree	Total	BoARD	ARARI	EPLAUA
MS	9	4*	5	-
BS	23	16*	5	2
G/Total	**32**	**20**	**10**	**2**

* One from MS and one from BS, both of them are from WOARD, withdrew without trace.

Table 53. List of students who completed MS and BS degree studies in local universities

No	Name of trainee	Partner institute	Field of study	Year of admission	Date of completion	Pending issues
	MS					
1	Bitew Genet Tasew	ARARI (Adet)	Soil and water cons.	Sept. 2003	April. 2005	Not any
2	Yonas Girma Abebe	ARARI (Debere Birhan)	Irrigation Engineering	Sept. 2003	Dec. 2005	“”
3	Zewdu Birhane Ayele	ARARI (Sekota)	Agricultural Economics	Sept. 2003	June. 2005	“”
4	Getanehe Wubalem Meshesha	BoARD (Regional office)	Agricultural Economics	Sept. 2003	June. 2005	“”
5	Muluken Bantayehu Nigatu	ARARI (Adet)	Plant breeding	Sept. 2005	June. 2007	“”
6	Tadesse Beyene Engda	BoARD (Regional office)	Agricultural Economics	Sept. 2005	Sept. 2007	“”
	BS					
1	Kokeb Bogale Engida	BoARD (LayGayint)	LaRMEP	June. 2003	July. 2007	“”
2	Lacketch Mitiku Egezinu	BoARD (Sekota)	LaRMEP	June. 2003	July. 2007	“”
3	Misganaw Teshome Ayele	BoARD (LayGayint)	DCHS	June. 2003	July. 2007	“”
4	Mekuria Yimer Gesese	BoARD (GubaLafto)	DCHS	June. 2003	July. 2007	“”
5	Aymiro Yeheyes Hailu	BoARD (Sekota)	ARWS	June. 2003	July. 2007	“”
6	Melkamu Ayalew Kebede	BoARD (GubaLafto)	DCHS	June. 2004	Sept. 2007	“”
7	Demerew Hailu Abebe	BoARD (Tehuledere)	LaRMEP	June. 2003	July. 2007	“”
8	Sitotaw Taffese Ayele	BoARD (GubaLafto)	Animal Sci.	June. 2003	Sept. 2007	“”
9	Dilnessa Ewnetu Feleke	ARARI (Combolcha rural tech.)	Mechanical Eng.	Sept. 2003	July. 2007	“”
10	Tefera Mekonnen Wolde	ARARI(DebreBirhane research ce.	ARWS	Sept. 2003	July. 2006	“”

Table 54. Detail information about students who are completing after December 2007

No.	Name of trainee	Admission date	Completion date	Partner institute	University	Dept	Status	Remark on completion date
	BS							
1	Tesfaye Setegne Zewdu	June 2003 (Summer)	July 2008	BoARD	MU	LaRMEP	Completed 3rd summer	Long overdue
2	Wolelaw Endale Ambie	Sept 2004 (Regular)	July 2008	ARARI	BDU	Mechanical Eng.	completed 4th year program	One semester after December, 2007
3	Aytenew Endeshaw Tatek	June 2004 (Summer)	July 2008	BoARD	MU	LaRMEP	Completed 4th summer	One semester after December, 2007
4	Mohammed Hussein Yimer	June 2003 (Summer)	Sept 2008	BoARD	HarU	Animal Sci.	Completed 4th summer	One summer after December, 2007
5	Ashagrie Melkamu Wole	June 2005 (Summer)	July 2009	EPLAUA	MU	NREM	Completed 3rd summer	One summer + two semesters after December, 2007
6	Biksegne Asfaw Endale	June 2005 (Summer)	July 2009	BoARD	MU	NREM	Completed 3rd summer	One summer + two semesters after December, 2007
7	Desalegn Abreha Worku	June 2005 (Summer)	July 2009	BoARD	MU	NREM	Completed 3rd summer	One summer + two semesters after December, 2007
8	Mesfin Bahita Tesfaye	June 2005 (Summer)	July 2009	ARARI	MU	NREM	Completed 3rd summer	One summer + two semesters after December, 2007
9	Teshome Getaneh Lule	June 2005 (Summer)	July 2009	EPLAUA	MU	Civil Eng.	Completed 3rd summer	One summer + two semesters after December, 2007
10	Tewodros Girma Abebe	June 2005 (Summer)	July 2009	BoARD	MU	NREM	Completed 3rd summer	One summer + two semesters after December, 2007
11	Addisu Bihonegn Eshetu	June 2005 (Summer)	Sept 2010	ARARI	HarU	Animal Sci.	Completed 3rd summer	two summers after December, 2007
12	Berhanu Fentaye Tadfesse	June 2005 (Summer)	Sept 2010	BoARD	HaU	Rural Devt	Completed 3rd summer	Three summers after December, 2007
13	Jemila Esleman Jibril	June 2005 (Summer)	Sept 2010	BoARD	HaU	Rural Devt	Completed 3rd summer	Three summers after December, 2007
	Ms							
1	Demrew Wesenyeleh Gossa	September 2003	July 2006	BoARD	HarU	Extension		Long Overdue
2	Tewodros Bimeraw Hailu	March 2006	July 2008	BoARD	MU	Animal Sci.	Busy with proposal Write-up	one semester after December, 2007
3	Binaym Desta Degaga	September 2005	July 2008	Debre Birhan research centre	HarU	Plant sci.	Busy with proposal Write-up	one semester after December, 2007

* Note: BDU= Bahir Dar University, HaU= Hawassa University, HarU= Haramaya University, MU= Mekelle University
LaRMEP= Land Resource Management and Environmental Protection, DCHS= Dryland Crop and Horticultural Sciences, ARWS= Animal Range and wildlife Sciences, NREM= Natural Resource Economics and Management

Short-term training

Numbers of short-term in-service trainings were organized for researchers, extension experts, development agents and farmers. In these technical trainings a total of 3414 (Table 55) participants benefited during the last five years. These different disciplinary trainings have helped to up-grade their knowledge, skill and attitude of the participants and as a result of which they have helped to improve implementation capacity of beneficiaries. Furthermore, some tailor-made courses targeted to tackle specific capacity needs were also organized. In this regard mention could be made for the major ones as follows:

- To improve the information dissemination capacity of our partner institutions (BoARD, ARARI and FSCDPO), a training course on web page designing was organized with Dr. Dawit Haile from Virginia State University (VSU).
- Training module development course for BoARD experts and researchers was organized with Dr. Albert Essel from Virginia State University
- Similar training on module development was also organized for East Belessa and Lay Gayint Woredas and Adet Research Center by a resource person who came from Agri-services Ethiopia and AMAREW project staff members.
- Leadership training was organized and offered to Lenche Dima watershed executive committee members by the staff members of AMAREW project
- To up-grade researchers' skill, training on research methodologies and data analysis for junior researchers was organized by AMAREW and ARARI (Table 55).
- Training on lab instrumentation and OFR was also organized by VSU.
- Community level participatory planning, project cycle-planning to evaluation and Community Organization Leadership Training for Action (COLTA) were another areas of training which were delivered to different stake holders.

Table 55. Summary of ANRS government staff short-term training types and number of trainees participated in the last five years

Year	Type of Training	No. of Trainees
2002	Woreda SMS	**30**
2003	Experience sharing and Field Training (Wello and Tigray)	9
	Experience sharing Trip to India (ARARI Staff)	11
	Strategic Planning – All ARARI Staff	211
	- DAs and Experts	26
	Soil and Water conservation (DAs*)	4
	Joint Forest Management (DAs)	2
	Irrigation (DAs)	19
	Horticultural crops production (DAs)	19
	Compost making and utilization (DAs)	13
	Pest assessment and IPM (DAs)	15
	Poultry production (DAs)	15
	Small ruminants production (DAs)	14
	Beekeeping (DAs)	30
	Fishery (DAs)	11
	Marketing of agricultural products (DAs)	10
	Basics of animal health/refresher (DAs)	39
	Integrated extension package (farmers)	115
	Participatory research and extension (DAs)	8
	Refresher training for DAs	27
	HIV/AIDS prevention (DAs)	58
	Family planning (DAs)	58
	Food habits and human nutrition (DAs)	16
	Fuel wood saving stoves (DAs)	25
	Study tour and experience sharing visits (DAs and farmers)	26
	Improve stove and food and nutrition (Farmers and DAs)	33
	HIV/AIDS and family planning (Farmers and DAs)	27
	Poultry production_ (Farmers and DAs)	45
	_DAs and animal health technicians (Farmers and DAs)	39
	Integrated pest management (Farmers and DAs)	48
	Natural resource management /soil and water conservation	48
	On-farm research and extension intervention options	55
	Recommended technologies, seed multiplications and diffusion	28
	Post-harvest potato handling and preparation of potato based dishes	5
	Year total	**1109**
2004	Technological packages (DAs and farmers)	28
	Highland fruits production (DAs and Farmers)	50
	Hay box brooder technology (DAs and farmers)	20
	Community organization and leadership skills (DAs and farmers)	5
	Compost making practical (DAs and farmers)	23
	IpM training (DAs)	3
	Farm implement (DAs and experts)	6
	Experience sharing (DAs and experts)	6
	Agro forestry and gabion production	35

	Taining methodologies for DAs, extension workers and Adet Agricultural Research Center researchers	21
	On-farm experimentation for DAs, extension workers and Adet Agricultural Research Center researchers	21
	Crop production and protection for extension workers	20
	Livestock husbandry for extension workers	30
	Natural resources management for extension workers	6
	Nutrition, HIV/AIDS and family planning	15
	Leadership and community organization	5
	Education tours (ARARI researchers)	27
	Year Total	**321**
2005	Inductive Training	45
	Crop production techniques and natural resource (DAs)	13
	Natural resource (DAs)	13
	Crop production	3
	Natural resource development (DAs)	10
	Fuel saving stove, family planning, nutrition and HIV/AIDS	70
	Year Total	**154**
2006	Training on drip irrigation for farmers	15
	Crop protection	24
	Establishment and running of Farmers-Research-Extension Group (FREG) for BoARD and ARARI technical staff	98
	Drip irrigation technology	3
	Vegetable crops	9
	Compost preparation	60
	IPM/FFS (WOARD staff)	60
	Hay box brooder technology and poultry management	2
	Construction of top bars and bee keeping	25
	Small ruminant management and forage	50
	Animal health and forage development	80
	Fishery product management	10
	Gabion making	69
	Livestock production and apiculture for DAs and experts	6
	FREG Training for experts and DAs Yeku watershed	3
	FREG Training for experts and DAs at Lenche Dima watershed	3
	FREG training for experts and DAs Gumet watershed	7
	Experience sharing tour	13
	Year Total	**537**
2007	Implementation modality for scaling-up (researchers, SMS and farmers)	113
	Bee keeping	310
	Small ruminant	43
	Land policy/land administration and certification/	68
	FREG implementation modality and follow-up	9
	Horticultural crop management	63
	FFS	108
	Scaling-out	220
	Potato seed production	10
	Inductive training	50
	Agro-forestry	95

	Integrated pest management(IPM)	24
	COLTA training	17
	Animal production and management	25
	Fingerling production and grow-out	18
	Development of seed potato marketing system	18
	Development of ware potato value adding and marketing system	17
	Development of Small ruminant grazing/browsing system	12
	An assessment of overgrazing and erosion complexity	12
	Development of small ruminant collective marketing and input use group	5
	Development of fish marketing system for Zege and St. George fishery production and marketing associations	12
	Upgrading of the existing seed potato growers nucleus group into cooperative status	5
	Lab-instrumentation	4
	Web-site dev't	1
	Agricultural mechanization	4
	Year total	**1263**
	Grand total (2002-2007)	**3414**

DAS=Development Agents, SMS= Subject Matter Specialists

Inductive training

Upgrading researchers' skill on research methodologies and data analysis was one of the activities performed based on specific capacity needs from junior researchers. Accordingly, an inductive training has been given to researchers in 2005 and 2007 physical years. In this training, about 95 participants (newly recruited and junior researchers) had stayed in the program for an extended period of time (one month) and meanwhile exposed to the various challenges and methods of agricultural research through classroom sessions and fieldwork experiences. The contribution of AMAREW project in this regard was; identification of training requirements, proper institute, resource persons, fund allocation and involvement in training delivery. A detail of the inductive training program is indicated in Table 56 below.

Table 56. Number of participants of inductive training program by research centre

Research centers	Year	
	2005	**2007**
Adet	10	11
Sekota	7	6
Debre-Birhan	4	8
Sirinka	8	10
Gondar	9	9
Andassa	4	2
BahirDar University	3	-
BFALRC*	-	2
BAMRC*	-	2
Total	45	50

Note: BFALRC= BahirDar Fishery and Aquatic Life Research Centre

BAMRC=BahirDar Agricultural Mechanization Research Centre

Fig.62 Inductive training graduation ceremony

Fig.63. Farmers training on Farmer, research and extension group (FREG)

Educational tours

In the project life time In-country and out of country educational study tours were organized for ARARI researchers, BoARD extension workers and farmers. These were the followings:

- **In-country**
  a) Six Woreda Agricultural Office Experts and four farmers of East Belessa Woreda traveled to Kobo, Dawa Chefa and Meket Woredas and visited successful integrated extension package activities; farmer managed small-scale irrigation schemes and natural resource interventions.
  b) Twenty Lay Gayint Woreda multidisciplinary Agricultural Office Experts made a comprehensive technical as well as organizational technology shopping tour and visited different institutions in the central and southern part of the country.
  c) Similarly, twenty seven farmers, two development agents and five Woreda agricultural office experts from Tehuledere woreda traveled to Guba Lafto Woreda and visited peasant associations practicing FFS/IPM technologies and formed the FFS/IPM group after returning from the tour.
  d) Nine researchers representing Sirinka and Sekota Agricultural Research Centers and from ARARI HQs made an educational study tour to North Wollo, South Gondar and Tigray. The group visited different successful natural resource activities carried out in these places. As a result of the tour they produced a document, which described and proposed actions in ANRS for a better natural resources management.
  e) Twenty seven ARARI researchers working in crop, livestock, natural resources management and socio-economics research areas visited research centers, successful development initiatives and made contacts with researchers working in federal research centers.

- **Overseas**
  a) Eleven researchers representing Adet, Sirinka, Debre Berhan, Kombolcha and Bahir Dar Rural technology research centres and ARARI HQs were sent to India for technology shopping and experience sharing visit. During the tour they have visited in and around three Indian Central Research Institutes working on dry land agriculture, agricultural implements and soil and water conservation. Furthermore, they have also visited the International Crop Research Institute for Semi Arid Tropics (ICRISAT). As a result they have come-up with technologies and ideas that could be adopted in ANRS. One which can be cited as an example is the Azola technology which is introduced to Adet research center and which is showing promising results

- The encouraging thing done by all participants regarding these different study tours (In-country and Overseas) is that, after returning from the tour all have

documented their experience and have clearly designed strategies that would help them put into action what they have learned from the tour.

4. Farmer to Farmer (FtF) program

Farmer-to-Farmer (FtF) is a program, involved in assignment of short-term volunteer technical assistances from USA. The program operates worldwide and has regional operations in different parts of Africa including East Africa. The East African program operates in Ethiopia, Kenya and Uganda and is being managed by Virginia State University (VSU). The program is a partnership program between Virginia State University and AMAREW project. The program is focused on giving technical support on **a*gricultural service development, farm income diversification*** and **n*atural resources development*** areas by volunteers (Table 57) who are coming from USA for a maximum of three to four weeks. In this program, significant activities had been performed during the last two years of intervention. The major activities which are executed are presented as follows:

- A total of 15 concept papers/Scope of Works/ were developed with the objective of seeking volunteer assignments on areas of market-oriented production in three focus areas: Horticulture five, Small ruminants seven and Fishery three (table 7).
- A total of 38726 (1582 direct and 37144 indirect) beneficiaries have received the technical assistance from the professional volunteers
- In the course of action, ARARI (the institute and different research centers under it), BoARD (the bureau and different districts under it), EPLAUA, Cooperative Promotion Agency, Ashraf Business Group (Sudanese Company), Zege and St. George fishery production and marketing associations, Farmers of potato, sheep and goat and fish, etc institutions have been involved and hosted the activities as per the type of volunteers who came to ANRS. The assignments which were fielded by volunteers had been helpful to the ultimate users of the assistance. Someone can ask that "What did the assignments deliver". Hence, the followings can be cited as some of the positive impacts of the volunteer assignments performed so far in the three focus areas:

Horticulture focused area

- Based on the recommendation of FtF volunteers in horticulture focus area
  - A model community for seed tuber production and marketing scheme was identified.
  - Farmers' income improved significantly (incremental net income per house hold per year Birr 1750) due to improved potato seed production
  - Diffusion of farmers' use of improved seed potato in the surrounding (many copy farmers are created).

- Volunteers:
  - Assessed the existing potato marketing system,
  - Recommended ways to ensure sustained supply of product to the forthcoming Injibara potato dehydrating plant,
  - Assessed other possible market opportunities for ware potatoes and determined quality demanded by domestic and export markets,
  - Suggested options for adding value and alternative uses of potato, and
  - Determined the need for collective marketing efforts (coop. establishment) and better access to market intelligence to enhance bargaining power of producers.

Small ruminants focused area

- assessed the current production and marketing system,
- Identified limitations and opportunities,
- Set recommendations on where and how the marketing collective action groups be organize, and
- Based on volunteers' recommendations preparations are under way to organize small ruminant rearing group

Fishery focused area

- **Volunteers**
  - Assessed the production systems and hence identified strengths and weaknesses,
  - Suggested practicable systems of commercial (for the associations) and subsistence (pond fish farmers) aquaculture production systems,
  - Indicated quality improvement strategies that could bring more economic benefits to those engaged in such enterprises,
  - Currently starter subsistence aquaculture producers are picking up recommendation from FtF assignment, and
  - The technical assistance provided by volunteers through training also played significant role in capacity building of fish researchers in the region.

Apart from this, volunteers recommended a lot of technical points in their respective disciplines so that beneficiaries can pick up some of the relevant recommendations and will adopt them to bring about improvement in the farmers' income and organizational capacity (Table 58).

Fig.64 Mr. Daniel Theisen, (a volunteer from University of Maryland), while he was delivering technical training to fish researchers in BFALRC

Table 57. Volunteers' profile, who are fielded in the three focus areas and hosted by AMAREW

No	Assignment No.	Assignment title	Focus area	Volunteers signed	Duration
1	AMAREW 04.1/2007	Development of seed potato marketing system	Potato	Mr.Terrill Christensen	Feb 3-17, 2007
2	AMAREW 04.2/2007	Development of ware potato value adding and marketing system	Potato	Dr Charles Basham	March 23-April 7, 2007
3	AMAREW 04.3/2006	An assessment of ware potato marketing opportunities	Potato	Dr. Roger Knutzen	April 3-20,2006
4	AMAREW 04.1/2006	Development of On-Farm potato seed tuber production and marketing scheme	Potato	Dr. Joseph Guenthner	May 20- June 3, 2006
5	AMAREW 04.4/2007	Upgrading of the existing seed potato growers nucleus group into cooperative status	Potato	Mr. Alan W. Laird	September 22-October 5,2007
6	AMAREW 06.1a/2007	Development of Small ruminant grazing/browsing system	small ruminant	Dr Ozzie Abay	May 9-24, 2007
7	AMAREW 6.1b/2007	An assessment of overgrazing and erosion complexity	small ruminant	Dr. Steve Oberle	May 11-24, 2007

Table 58. Assignment description, name of volunteers and list of recommendations

No.	Assignment	Name of Volunteer	Date of Assignment	Recommendations	Recommendations adopted by host	Follow up assignments for FY08
1	Assessment of Ware Potato Marketing Opportunities	Roger Knutzen	April 3-20, 2006	• Working towards an industrial-base economy • The country should enter the WTO as a least developed nation • Working towards commercializing the agricultural-sector • Establishing a link between research and extension • Organizing agricultural cooperatives • Eliminating the many layers between the farm gate and the end user • Privatization of the land • Develop irrigation project • Use the hybrid true potato seed • Establish potato processing plant	• Potato dehydration plant at Injibara is going to be established • Currently preparation is underway to enter the WTO by the government (Although it is beyond the scope of the assignment) • The value chain approach is being followed for potato (Linking production to industries and ultimate consumers is in progress) • A nucleus group of 15 producers produced significant amount of basic seed and generated higher income from this venture. • Formation of FREGS in pilot woreds is underway	• Assistance to the forthcoming potato dehydration plant at Injibara
2	Development of On-Farm Potato Seed Tuber Production and Marketing Scheme	Joseph Guenthner	May 20-June 3, 2006	• Continue to promote clean seed and suitable varieties • Continue efforts in storage development and management • Continue community-based program, DA involvement and cooperative development • Develop a color-coded seed identification system • Develop seed potato planting packs • Contact Technico[1]	• Seven improved potato cultivars distributed to 77 producers. • Efforts underway to privately construct DLS from locally available resources by the seed potato producers. • DA involvement in seed potato production improved significantly.	

[1] An Australian firm with global operations in high-tech seed potato production

3	Suggesting Improvement in Aquaculture Production System	Brian Nerrie	July 8-23, 2006	• Continue the regulation and their enforcement of commercial fishing on Lake Tana • Encourage fisheries associations to attain cooperative status • Improve post-harvest fish handling, processing methods, and waste management with respect to food safety and environment • Assist fisheries cooperatives/farmers to expand production through pond aquaculture • Keep production systems simple with focus on tilapia subsistence and commercial levels • Examine local feedstuffs as fish food • Develop training programs for research, extension and farmers • Upgrade the fish marketing system • Overcome production system issues before expanding to new species	• Regional fish resource utilization policy, which entertains enforcement, has been developed. • Fisheries associations improve fish production, fish handling and marketing (i.e. Purchased two additional deep freezers, Purchased two additional Boats) • The associations have also accessed themselves to micro-credit and received a total loan of 200,000 Birr, from small and medium scale enterprise promotion agency in the region, to expand their production. • Training delivered to researchers on Tilapia fingerling production and grow-out • New Billboard, St. George fresh nutritious Lake Tana fish, has been posted in front of the association's office to advertise the fish market.	
4	Assessment of Improved Small-Ruminant (Sheep and Goat Rearing and Marketing opportunities with emphasis on assessing the current production systems, opportunities and design of workable production strategies.-debre Birhan, Dese, Weldiya,Sekota, Debre Tabor, Dangla, Sekela, Gish Abay and Gondar.	Judith Moses	July 23-August 10, 2006	• Separation of young stock from dams during the night to provide supplementation and to lessen competition with adult animals • Provide training on lamb and kid finishing methods, nutritional management requirements as a micro-enterprise project for a small group of interested producers • Provide training on body condition scoring for goats and adapted scoring for fat tailed sheep, inner eyelid/gum color for health and parasite issues and other simple health and conditioning checks.	• Based on FtF volunteers' recommendations, hands-on ToT training sessions were organized for those who after receiving the training shall train producers • Hence 23 mentors trained on body condition scoring for goats, methods that minimize competition from adults to young stock, surveillance and diagnosis of seasonal disease, elimination of inferior breeding males, elimination of random breeding (Castration of unwanted male genetics)	Veterinarian volunteers with expertise on small ruminants and tropical diseases

				• Disseminate information and pilot techniques for improved grazing methods such as the binding rest program for vulnerable areas (Sekota Woreda methods), Cut-and- Carry (no graze), or other appropriate grazing methods. • Provide training and information on surveillance and diagnosis of seasonal disease outbreaks. • Provide producer and extension agency training and support on common disease symptoms, treatments, medications, and simplified posting (autopsy) techniques after death. • Improve housing situation initially for young stock and female breeding stock considering social implications or resistance. • Provide training on management requirements to supply purebred or specific cross-bred options as a micro-enterprise. • Provide training on selection methods for the commodity goat and sheep producer and methods of eliminating inferior/random breeding methods. • Continue the research of native breed potential such as the Barka goat and the Dangila and Bonga sheep • Re-initiate distribution of Meadi free Awassi rams when ready and import additional rams or semen when available. • Additional supports and resources for extension offices and research centers in the form of basic lab availability, training, software, reference materials, funding for trials.		

				• Expand tree, browse, and grazing variety nurseries for planting in yards, degraded areas and around private plots. • Expand farmer training school programs (similar to Sekota woreda).		
5	Assessment of Improved Small-Ruminant (Sheep and Goat Rearing and Marketing opportunities with emphasis on assessing the current marketing system, opportunities and development of marketing strategies that benefit producers and traders- Debark, Farta and Debre birhan	Larry Jacoby	August 20 – September 2, 2006	• Install parasite control program. • Improving adequate weight gain, meat carrying capacity, carcass yield, and finishing through local breed selection and feed management • Improve transportation system • Standardize animals brought to abattoirs, follow strategies to bring animals to slaughter weight by on site feeding • Introduce marketing system such as ear tattooing, notching, scarification, tagging, etc. • Promote trade relations with Sudan • Organize producers into collective input use and marketing groups, supply credit and other inputs to organized groups • Pastureland improvement and reorganization • Design system to provide market information to farmers. • Increase the number of highland shoats processed by abattoirs. • Encourage the brand recognition of Ethiopian Grass-Fed Natural marketed as a superior product, not as a commodity.	• Asheref industry business group, Sudan based company, with a capacity of 1500 shoats per day is under construction. This will be a potential market for farmers around it. • AMAREW project with collaboration to ARARI prepared a concept paper to establish small ruminant production and marketing groups (Model farms). After the approval of the budget, it will be implemented in the near future. Hence attempts underway to organize 3 collective groups (1 at Sekela (sheep), 1 at Sekota (goats) and 1 at Adet (sheep).	• Strategy development for Pastureland improvement

6	Assessment of Improved Small-Ruminant (Sheep and Goat Rearing and Marketing opportunities with emphasis on the provision of professional training to producers, traders and development workers that ensures better returns to producers and traders-A/A, Debre Birhan.	Steven Weerts	Septemeber 13-21, 2006	• Train agricultural extension agents to solve the problems with small ruminant rearing and marketing. • Develop a curriculum for farmers training in the production of sheep and goats. • Obtain experts who can teach meat exporters, owners of slaughtering facilities and extension agents about improving the export market for sheep and goat meat.	• After organizing marketing groups, tailored training for farmers about small ruminant rearing and marketing will be given	
7	Assessment of Improved Small-Ruminant (Sheep and Goat Rearing and Marketing opportunities with emphasis on the provision of professional training to producers, traders and development workers that ensures better returns to producers and traders Debre Birhan, B/Dar	David Kier	Sept.14-25, 2006	• Perform study using existing flocks of sheep to make extensive treks. • Setup model rearing through existing cooperative family groups. • Encourage use of weight estimate method • Encourage direct contact between the abattoirs and farmers. • Work on water storage development. • Establish small farmer groups and empower them to have information on production and marketing.	• Direct contact will be made between the shoat farmers around BahirDar and Asheref PLC.	
8	Development of Seed Potato Marketing System	Terrill Christensen	February 2-18,2007	• AMAREW together with its partners develop seed distribution networks that can be tracked from the beginning (tissue culturing) to the end (processing plant or local market). • Find proper storage for the seed potatoes. Construct Diffused Light Store (DLS) • Study possible dark cool storage. • Use extension agents to encourage and teach the growers of the benefits of self government and self improvements so that the formation of seed growers association will be viable and sustainable.	• Draft strategy on how to sustainably link production to consumption markets has been developed at the regional level • Lab equipments for potato tissue culturing have been fixed at ARARI. • Seed potato producers vigorously increased in number from 15 to 77 in the Gumet water shed area. • Seed potato producers constructed one additional DLS in cooperation. • Further more members are planning to privately construct additional DLS from locally available resources.	

				• The regional directors should give attention to the road that will help get the commodity to market from remote areas (improve the road infrastructure). • Incentives to farmers to make them more cooperative for the work needed. • The extension agent should deliver technical training which has a comprehensive set of records for each lot of seed provided by the Research Institute to the seed farmer and the increase of planting material. • The extension agent should also visit the ware-farmers and train them with the benefits of using new seed, such as better quality and higher tonnage. • Provide incentive for development agents who are working with seed growers.	• A team of AMAREW project staff, Woreda SMS, development agents and farmers had cross-site visit to seed potato growers area (Holeta) as an incentive to work more in this venture (Potato farming). • In collaboration with different stake holders, preparation is underway to organize **ware-potato** producers group (Just to link to **seed potato** producers group) • The rural road which connects the PA to watershed, that will help get potato seed to the market, have been maintained using community labor and local resources.	
9	Development of Ware Potato Value Adding and Marketing System	Charles Basham	March 21-April 5, 2007	• Establish simple grading standard. • Establish a market intelligence system with at least weekly reporting of market prices in selected cities. • Make available plans and financing for construction of low cost, low tech storages to individual farmers and cooperatives. • Strengthen and focus on establishment of cooperatives on potatoes • Improvement in the management of the forthcoming Injibara plant. • Insistence upon use of certified seed of approved cultivars should be made a part of contractual arrangements with growers through their cooperatives. • Establish an Integrated Pest Management program for potato production.	• Seed potato producers in Gumet watershed area constructed one additional DLS in cooperation. • Further more members are planning to privately construct additional DLS and ware potato storage using locally available resources. • Attempt is underway to upgrade the existing seed potato growers group in to cooperative status • Additional FREGS established in potato production areas • Currently market for agricultural produce, especially for potato and livestock products, is being created due to **Sudan** companies. • Award already given for the construction of fence for Injibara potato dehydration plant.	• Establishment of an Integrated Pest Management program for potato production.

				• Set quality standards as part of production contracts. • Recruit farmers with irrigation capabilities with payments bonuses for out-of-season production. • Recruit coops to serve as contracting agents for their members. • Evaluate the market for potato-based snack food products such as chips. • Expansion of the market in Sudan should be pursued vigorously. • Encourage and support FREGS.		
10	Feed resource assessment and utilization of browse vegetation for small ruminants-Bahir Dar, Sekela, Lay Gayint, Farta, Guba Lafto and Sekota	Ozzie Abaye	May 7-25, 2007	• Immediate attention to **Sekela** and **Sekota** areas as there is overgrazing and the ecosystem is at alarming level (rotational stocking may be used as a means to prevent further degradation and increase pasture productivity) • Implement management schemes to reduce disappearance of browse species. • A follow up study on alternative feed resources, ecology, and improving soils for increased crop/pasture production. • Expanding farmer–and community driven land conservation approaches • Assess alternative management strategies on public grazing land • To reduce extreme grazing pressure on the public lands, farmers need alternative feed resources when livestock feed is in short supply such as: o Ensiled materials o Introduction of back yard alternative supplemental forages for cut and feed o Introduction of improved breed (increase feed efficiency	• Community based watershed management whereby Cut-and – Carry system to increase feed efficiency and reduce extreme grazing pressure is being adopted at Lenche-Dima watershed. • Researchers at Sekota promised to exercise to ensilage “Cassia” to improve feed availability in the area • Based on the volunteer recommendation, a follow up assignment is going to be fielded in GIS technology in Sep-Oct, 2007	• A study on alternative feed resources such as introduction of new forage species that can be easily established and harvested several times during the growing season and adapted to low fertility and drought condition and will persist year to year under diverse management scheme. • Ecological study which help trace and reduce the increasingly disappearing native species (grassland and browse species).

				• Expand holistic and integrated natural resource conservation • Expand the utilization of GIS technology for integrating existing and future research information.		
11	An Assessment of Overgrazing and Erosion Complexity-B/Dar, Woldiya, Lenche Dima watershed, Lay Gayint, Debre Tabor, Sekela, Gumet watershed.	Steve Oberle	May 11-25,2007	• A follow up study on alternative feed resources, ecology, and improving soils for increased crop/pasture production. • Expanding farmer–and community driven land conservation/protection approaches • Assess alternative management strategies on public grazing land • Expand holistic and integrated natural resource conservation and protection approach • Expand the utilization of GIS technology for integrating existing and future research information. • Improve and expand soil sampling and testing efforts across the region and country for increased crop/pasture production and nutrient efficiency		
12	Development of fish marketing systems for Zege and St. George fishery production and marketing association	Perry Raso	July 18-August 7,2007	• Coach farmers to adjust stocking densities over time to maximize the tilapia yield • Teach farmers to use nested hapa net method so that they can sort out fish according to size. • Introduce a predator species • Work on improving fish harvesting and processing techniques (e.g., create and maintain a cold chain) • Work on improving storage techniques (e.g., rotate product, put fillets on wood, plastic...) • Use a model to predict sustainable harvest of fish from lake Tana • Locating gear supplier to get fishermen necessary gear	• Preparations under way to introduce Cat-fish as a predator for Tilapia fish at the research station level	• Predicting techniques (for models) sustainable harvest for Lake Tana fish resource using

				• Establish and enforcement of well defined fishery regulations • Enforcements of proclamation 92/2003 • Train fisheries inspectors • Monitoring Asheref Business Groups impact on local fisheries and availability of fish for consumption in B/Dar • Data collection on current fish stocks. • Establish catch limits • Regulate mesh size		
13	Training on Mono-sex tilapia pond aquaculture and fingerling production-B/Dar, DebreElias and Enemay	Daniel Theisen	July 18-Augus t 8, 2007	• Identify pockets of motivated farmers where a single extension agent can easily and frequently visit them. • Establish with a farmer a management strategy • Build a greenhouse hatchery • Request seines and waders from FtF • Improve water source to be shared by hatchery, holding area and ponds • Create a working relationship with Suliman Galal of Ashraf Industrial Group PLC.	• Preparations already made to build greenhouse hatchery with an adjacent holding area in an existing building	• Technical assistance in building a greenhouse hatchery for fingerlings

5. On going activities requiring attention

As part of the long-term training plan the project has been financing the studies of **MS** and **BS** students. Long–term training of selected development workers of AMAREW partner institutions has been taken as one of the principal means for building the human and institutional capacity of ANRS partners. To achieve this, the project, together with the partner institutions, identified missing links and key areas that should be strengthened through enhancing academic qualifications of partner institutions' staff. This was implemented by facilitating the recruitment of appropriate candidates, assisting candidates, assisting candidates in securing placements and sponsoring their studies. Along this line, nine MS and twenty-three BS study opportunities were given to employees of the project's ANRS partner institutions. ANRS partners should place the trainees in appropriate positions to have them contribute to the development of the region. Along this line, two MS and twelve BS students are not expected to complete their studies by December 31, 2007. Hence with the financial and administrative support, the ANRS partners should ensure that these students complete their studies and contribute to the ANRS development. Beneficiary institutions (ARARI, BoARD, and EPLAUA) should follow-up and make the necessary arrangements for enabling students in the long-term training program to complete their studies and join them with their newly acquired levels of education. The total expected budget requirement for the remaining students to finalize their studies is about Birr 150000.Therefore, this cost is expected to be covered by the respective partner institutions as per the number of students. A detail of the pending cost is indicated on Table 59 below.

Furthermore, attention should also be given to FtF activities which are on the pipe line. Volunteers, after assessing contradictions, challenges, and opportunities that exists in three focus areas, i.e. potato, small ruminants and fish, they have given their professional recommendations and hence, need to be picked-up and be implemented by the relevant organization (ARARI and BoARD). Tangible advances have been made, especially; in the areas of quality seed production and as a result significant income increment have been achieved at individual household level. In this respect, the role played by volunteers had been significant. Hence, promoting and expanding the initiatives and ideas of these volunteers at the regional and Woreda level will be important. For market-oriented production to develop, considering the following pending (started by FtF and partners should takeover) issues will be imperative:

- Organize the existing ***nucleus group of seed potato growers in to cooperative and link to the ware potato growers and the forthcoming*** Injibara potato dehydration plant.
- Supply credit and other inputs to organized cooperatives
- Finalize the attempt already made to organize small ruminant rearing farmers group in Sekela, Adet and Sekota.
- Provide technical assistance to the emerging pond aquaculture and to the improvement of fish marketing.

In the three focus areas of intervention, which are mentioned above, stick to the value chain approach and give emphasis for value adding.

Table 59. Budget requirement for students completing after December 2007

No.	Name of trainee	Tuition fee	Stipend	Transport	Binding	Advisor's fee	Thesis document	Total	Institution/place of work
1	Wolelaw Endale Ambie	-	-	-	-	-	-	-	B/Dar rural technology
2	Aytenew Endeshaw Tatek	-	-	-	-	-	-	-	East Belessa WOARD
3	Mohammed Hussein Yimer		360	900				1260	GubaLafto WOARD
4	Sitotaw Taffese Ayele	-	-	-	-	-	-	-	GubaLafto WOARD
5	Ashagrie Melkamu Wole	15000	1560	1280				17840	GubaLafto EPLAUA
6	Biksegne Asfaw Endale	15000	1560	1280				17840	LayGayint WOARD
7	Desalegn Abreha Worku	15000	1560	1280				17840	East Belessa EPLAUA
8	Mesfin Bahita Tesfaye	15000	1560	1280				17840	Sirinka research centre
9	Teshome Getaneh Lule	15000	1560	1280				17840	Sekota EPLAUA
10	Tewodros Girma Abebe	15000	1560	1280				17840	TehuleDere WOARD
11	Addisu Bihonegn Eshetu		1080	2700				3780	Sekota research centre
12	Berhanu Fentaye Tadfesse	11100	1080	2970				15150	Sekota WOARD
13	Jemila Esleman Jibril	11100	1080	2970				15150	East Belessa WOARD
14	Tewodros Bimeraw Hailu			800			1000	1000	East belessa WOARD
15	Binyam Desta Degaga				3000	3000 ?	1000	7000	DebreBirhan research centre
	Grand Total	22200	12600	17120	3000	3000	2000	**149120**	

6. Problems encountered in the course of project implementation

- Huge reduction in training plan due to budget reduction from USAID
- High rate of staff turnover
- Inappropriate assignment of trained personnel
- Lack of emphasis for training
- Lack of training needs assessment
- Lack of training impact evaluation.

7. Lessons learned and recommendations

➢ Lessons learned

- AMAREW project placed particular emphasis on the importance of human capacity building to ensure integrated rural development in its food insecure pilot Woredas.
- Hence more than 30 professionals have been trained in long-term degree program and thousands of extension staffs and farmers have received short-term trainings, this helped a lot to fill missing expertise and technical skills. As a result, it was having huge impact on technology adoption and productivity increment.
- This was a great achievement given the short time the project existed, relatively being under funded and having small personnel.
- Based on the needs of partners of the AMAREW project professional volunteers provided technical assistances. Hence, apart from impact on farmers' income increase, volunteers' assistance has been a good opportunity for capacity building of researchers and extension workers.
- It has also created a chance to make cultural linkage between citizens of USA and Ethiopia.

➢ Recommendations

- The ability of agricultural R and E to fulfill its role is largely dependent on the competence and motivation of its workers and supporting staff and hence human capacity building should be given higher priority and pressed forward.
- Not only human but also institutional capacity building at all levels should be made through regular program.
- By recognizing the critical importance of human capital, it is essential to integrate human capacity building within overall social and economic development strategy of the region.
- However, an attempt of capacity building should depend on need assessment in order to avoid the misuse of training.
- As FtF program had been useful in the past, effort should be made to further work with volunteers.

Recommendations for Continuation of Project Initiated Activities

AMAREW was initially designed to enable ANRS partners to continue with Project activities with full ownership and knowledge of the activities when the Project terminates. In fact the owners and implementers of the Project activities have all along been the ANRS partners by design. Hence, continuation of Project activities by the owners should follow smoothly when the Project phases out by December 31, 2007. The paragraphs below highlight selected elements of continuing activities to give pointers of the AMAREW Exit Strategy.

1. Since its inception, AMAREW has been engaged in supporting on-farm adaptive research as a basis of knowledge-based agricultural transformation primarily in the food insecure woredas in a bid to contribute to the multifaceted efforts of the ANRS to curb the deep-rooted abject poverty desolating the region in general and the farming community in the target woredas in particular. To the satisfaction of all partners involved in this endeavor, a significant number of technologies were jointly identified by the researchers, extensionists and above all the farmers in the respective areas, which should bring about a noticeable positive change the livelihood of the target groups. AMAREW has, therefore, taken the initiative to persuade all the stakeholders so that they would embark on **scaling up or out of these viable technologies** during the 2007 fiscal year. Accordingly, different technologies that have been proved rewarding have been selected for scaling up or out by each partner ARARI Research Center. Examples include: improved varieties and production practices of sorghum, tef, bread wheat, barley, faba bean, chickpea, potato and vegetable seed production. But the scaling up or out of the technologies, in order to be sustainably successful, needs a continuous follow up and commitment of stakeholders for which the relevant research center should play the leading role. Therefore, AMAREW will handover to ARARI the task of playing pivotal role so that the process of scaling up of technologies will have continuity and prosperity.

2. At each partner research center, there will be a number of **on-farm research activities** that should continue after the termination of AMAREW. ARARI has to takeover the budget requirement and support the respective research centers so that they will continue the on-farm research activities.

3. In order to **strengthen the seed system** in the region, AMAREW Project has organized pilot Collective Potato Seed Production and Marketing Action Groups in two pilot woredas, Sekela and Lay Gayint. Both action groups were organized in a way to evolve into a private scheme specialized in seed production and marketing to be identified as a Cooperative Community-Based Seed Enterprise (CCBSE). These groups need to be strongly assisted in the coming few years until they become self-reliant. Therefore the Adet ARC in collaboration with the WOARDs of Lay Gayint and Sekela will have to continue working with the respective groups towards the maturity of the seed program.

4. AMAREW has been working hard to bring about a paradigm shift in the perception as well as practice of the **research-extension-farmer linkage** in the region. Although there are some positive and earnest changes in the direction, there are still a lot of obstacles, especially at top-management levels, to fully internalize the notion of partnership as a pathway to agricultural development of the region and beyond.

5. AMAREW organized recently a final workshop, whereby all the key AMAREW stakeholders took part and **the task of maintaining and strengthening research-extension-farmer linkage to BoARD, ARARI and other partners of relevance** was discussed and all agreed that the BoARD should play the the major leadership role in this respect.

6. At the watershed level the **Community Watershed Management Organization (CWMO)** and kebele leaders can potentially serve as focal points for mobilizing communities for collective and individual development actions, therefore DAs and woreda experts should play a major role in further strengthening CWMOs in all the pilot watersheds.

7. Efforts to make participatory or **joint research-extension-farmer planning, implementation, and monitoring** have to be continued at woreda and watershed levels. The WOARD should lead this effort.

8. Each pilot WOARD should encourage improved seed exchange among farmers by seriously **following the revolving seed credit scheme** initiated by AMAREW and continue working towards organizing the planned seed bank system in the coming years.

9. Attention should also be given to enhancing **improved livestock production and management package through a revolving credit scheme** established in the pilot watersheds and woredas by AMAREW so that more beneficiaries can be reached.

10. Efforts should continue at the woreda and kebele levels for soil and water conservation activities implementation and scaling up **following the watershed model.**

11. Focus on **scaling up of technologies in natural resources** with proven performance such as closed area management, gully rehabilitation and development, water harvesting and development, *in situ* water harvesting and conservation, multipurpose tree planting, etc. have to be continued by the WOARD and the CWMOs.

12. Efforts in promoting and expanding **micro-enterprise development and income generating activities** at the watershed and woreda levels, such as fuel saving stoves, making gabion boxes, honey production with modern bee hives, seed production, small ruminants production etc should be followed up aggressively. The major responsibility of these activities should be that of the WOARDs.

13. **Woreda experts and DAs should play a major role in strengthening communication** between the various sector agencies operating in the woreda, as for example, link the land rehabilitation and management work with the available forms of support such as the safety net program at the woreda level; the resources available through this program can be efficiently used to scale up the successful watershed models and continue treating more degraded areas in various land use categories under the watershed approach.

14. **Distributing treated closed areas to landless youths** is a good and sustainable practice if there is close follow-up, provided that it is done in participatory manner such as in the Lenche Dima watershed. Such an approach should continuously be evaluated and needs to be further expanded to other watersheds in the ANRS.

15. The BoARD, Zonal, and WOARD experts have to closely **follow up and monitor the work begun at the pilot watersheds on a regular basis.**

16. **Integration of research, extension, and farmers** as practiced by AMAREW in the course of **annual work plan development, implementation, monitoring and evaluation** will have to be continued by BoARD and WOARDs. The useful lessons learnt from the joint review and planning workshops of the Project should also continue.

17. **Farmer, Research and Extension Groups (FREGs)** support should continue as an effective mechanism for technology transfer and multiplication. Technology targeting should be carefully devised through homogeneous target groups identified on the basis of resources and constraints behind individuals. This should be the joint responsibility of ARARI, BoARD, and the respective WOARDs.

18. Transfer of Technology is a practice that calls for adequate combination of extension related activities such as credit, input delivery, training, etc. AMAREW's practice of technology promotion since 2002 has been geared through adequate **coordination of technological input, training, and credit provision.** The successful experiences gained should be continued and expanded by the WOARDs.

19. Long-term training (MS and BS levels) of selected development workers of AMAREW partner institutions has been taken as one of the principal means for building the human and institutional capacity of the ANRS partners. To achieve this, the Project, together with the partner institutions, identified missing links and key areas that should be strengthened through enhancing academic qualifications of partner institutions' staff. This was implemented by facilitating the recruitment of appropriate candidates, assisting candidates in securing placements and sponsoring their studies. Along this line, nine MS and twenty-three BS study opportunities were given to employees of the Project's ANRS partner institutions.

ANRS partners should place the trainees in appropriate positions to have them contribute to the development of the region.

20. One MS and 14 BS students are not expected to complete their studies by December 31, 2007. Hence with the financial and administrative support, the **ANRS partners should ensure that these students complete their studies** and contribute to the ANRS development. Beneficiary institutions (ARARI, BoARD, EPLAUA) should follow-up and make the necessary arrangements for enabling students in the long-term training programs to complete their studies and join them with their newly acquired levels of education.

21. Finally, in December 2007, the last month of AMAREW's operation, the Project team traveled to all of the Project's pilot woredas, watershed sites, and research centers and announced the termination of the Project and discussed with all stakeholders about the importance of the continuation of the activities initiated by Project. The major issues which neeed to be followed up by each AMAREW partner was highlighted and consensus reached.

Strengthening Research-Extension-Farmer Linkage: The AMAREW Project Experience and Perspectives*

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1. Background

The Virginia Tech and its consortium members implemented and USAID supported **A**mhara **M**icro-enterprise development, **A**gricultural **R**esearch, **E**xtension and **W**atershed management (**AMAREW**) Project original document emphasizes that shifting the research and technology transfer paradigm is a corner stone in the establishment of the project. The document further stresses that for the overall project goals to be achieved, strengthening research and technology transfer in agriculture, and natural resource management requires a change in the current practices of the implementing actors. The emphasis on paradigm shift in research and technology linkage stems from the historically weak linkage between these two entities.

Bringing about this paradigm shift within the Amhara National Regional State (ANRS) envisioned the development of strong and long-term partnerships among collaborating research and extension services. The AMAREW establishment document emphasizes that the new paradigm must encompass effective communication, cooperation, and collaboration among and within all of the separate institutions involved in agricultural development of the ANRS. Most importantly, partnership building must be centered on a common goal – implementing innovative and successful customer-focused participatory methodologies throughout the adaptive research/technology transfer continuum.

The project document assumes that the community-driven and service-oriented concept behind the land-grant model of US Title XII institutions offers an effective strategy for engaging communities and linking research and technology transfer for solving real-world problems. The implementation of the US land-grant universities' tripartite mission of research, extension, and education has contributed greatly to the success of agricultural and related businesses in the US and elsewhere, such as in India, where it has been conscientiously applied. The VT Consortium implementing the AMAREW Project believes existing research and technology transfer institutions must be respected, and the Project set out to work with these institutions to functionally reproduce the successes of the land-grant model in order to promote the necessary cooperation, communication and collaboration to achieve the goal of food security for the ANRS.

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Stronger linkages between Amhara Regional Agricultural Research Institute (ARARI) and Bureau of Agriculture and Rural Development (BoARD) should be created and maintained through continuing focused discussions on joint collaboration in the pilot woredas and watersheds of the Project. AMAREW was launched with the full expectation that an agreement at the regional level will be in place to authorize the development of joint work plans by inter-service teams in the targeted pilot woredas of the project. The project document highlights that when community extension and research is jointly designed and carried out by local agents from different services, then true collaboration will exist and the most important research/extension linkage of the land grant university model will have been established.

With this background, one of the stated objectives of the AMAREW project is to assist the efforts of the ANRS to bring about a major change in the process of planning and implementing agricultural research and extension, in such a way that farmers and all stakeholders would play a pivotal role in defining the course of agricultural research and extension in the region. Accordingly, the pilot integrated watershed management areas are serving as sites for integrating research, extension, watershed management and micro-enterprise development efforts. Similarly, the pilot extension woredas are serving as pilot woredas for functionally integrating research and extension at woreda level. Consequently, production and productivity of rural households in the ANRS can be increased through the availability and transfer of agricultural technologies. As a further consequence of this action, rural income can also be increased through participatory agricultural research and extension by giving technology users an important say in technology development, and transforming a top-down, supply-driven technology transfer system to a bottom-up, demand-driven one.

2. History and Evolution of the National Research and Extension System

It is essential to review briefly the past history and evolution of the research and extension systems in the country if a meaningful and new strategy is to be charted for these entities to work together more effectively. The research and extension systems in the country have evolved significantly over the last 50 years. The sections below highlight the various changes the systems have gone through.

2.1 The Land Grant Model Era under the IECAMA: During the late 1950s and the early 1960s the Imperial Ethiopian College of Agricultural and Mechanical Arts (IECAMA) at Alemaya assumed the national responsibility for agricultural Education, Research, and Extension, replicating the successful land grant model of the USA. IECAMA's national responsibility in research and extension were taken over by newly formed organizations as mentioned below.

2.2 Department of Agricultural Extension of the MoA:

In 1963, agricultural extension was transferred from the Alemaya College of Agriculture to the Ministry of Agriculture (MoA) where it became the Department of Agricultural Extension (DAE), which was then organized into three units, namely Field Service Unit (FSU), Youth Club Unit (YCU), and Training Unit (TU). During this period the FSU had established 120 development centres throughout the country. The major duty of the YCU was establishing school clubs and promoting horticultural crops production and utilization where the main actors in that production and utilization were women farmers, which led to recognizing the importance of women extension agents. The TU was responsible for all extension related training activities.

2.3 The Establishment of the IAR:

Focusing on the research function, in 1966, the Institute of Agricultural Research (IAR) was established, as an autonomous entity assuming the national mandate for addressing all agricultural research issues of the country. Over the years, IAR and its later designation as Ethiopian Agricultural Research Organization (EARO), and its current identity as Ethiopian Institute of Agricultural Research (EIAR) has addressed not only national agricultural research issues but has also attempted to promote and implement research-extension linkages. A couple of the well-known linkage attempts spearheaded and driven by the IAR over the years are Research and Extension Liaison Committee (RELC) and Research Extension Farmer Advisory Liaison Committee (REFALC).

2.4 The Comprehensive Package Projects:

Beginning with the late 1960s, mainly with donor support, the Ethiopian government initiated various comprehensive package development projects focusing on defined geographical areas. Financed by the Swedish International Development Authority (SIDA), the first comprehensive package project called Chilalo Agricultural Development Unit (CADU) was established in 1967 in Arsi zone in the then Chilalo Awraja. This pilot project was initially implemented in one Awraja with the aim of scaling it up to other parts of the country. The project was comprehensive where in addition to regular agricultural research and extension activities, infrastructure development, marketing, credit, seed multiplication, improved farm implements production, and the like were included.

In 1970, another comprehensive development package project known as Wolayita Agricultural Development Unit (WADU) was established, with the support of the World Bank, in the then Sidamo Administrative Region in Wolayita Awraja. Motivated and selected model farmers were identified and technology demonstrations were carried out on their fields with the objective of extending such technologies to a wider group of farmers in the surrounding communities.

Based on the CADU and WADU experiences, other comprehensive package projects with varied objectives but almost similar approaches were initiated with the financial assistance obtained from different countries. The notable ones were

Ada District Development Project (ADDP), Tache Adiabo and Hedekit Agricultural Development Unit (TAHADU), Southern Region Agricultural Development Project (SORADEP), and Humera Agricultural Development Project (HADP).

The comprehensive package projects showed encouraging achievements in their respective focal areas where each project was implemented in terms of improving agricultural production and productivity in gross terms. However, such comprehensive package projects had numerous drawbacks among which were the use of capital intensive and expensive production inputs. Consequently, there were difficulties in replicating these successful experiences elsewhere in the country. As a result, in the 1970s, less capital-intensive technology dissemination systems were sought, designed, and implemented throughout the country.

2.5 Extension Project Implementation Department (EPID):

As an alternative to the comprehensive package projects, in 1971, the Ministry of Agriculture initiated the nation wide Extension Project Implementation Department (EPID). The extension system that was known as Minimum Package Project (MPP-I) during the 1971 to 1979 period had the main objective of providing small-scale farmers with essential agricultural extension and support services. During MPP-1, the major techniques and technologies promoted included fertilizer application, improved seeds and crop management, crop protection technologies, grain storage, agricultural implements, soil and water management techniques, home economics, horticulture, and animal husbandry techniques. In 1979, EPID was dissolved and its extension activities were taken over by different MoA departments organized on a commodity and discipline basis, which included crop production, livestock production, forestry development, soil and water conservation, and cooperatives promotion.

2.6 MPP-II extension system:

As an extension to the MPP-I, a follow-up program known as MPP II was developed in 1980 during the Derg Regime and was financed by the World Bank, IFAD, and SIDA. The MPP-II extension system assigned one Development Agent (DA) to 10-15 Peasant Associations (PAs) and improved techniques and technologies were demonstrated on about five model farmers' fields in each PA.

2.7 PADEP and the TandV System:

In 1986, the then MoA launched the Peasant Agriculture Development Program (PADEP) with the major objective of decentralizing the power of the central MoA to seven geographically set development regions. PADEP adopted the World Bank favoured Training and Visit (TandV) extension system and was funded by different donor agencies. The TandV system established good linkage of the extension system with research and played a significant role in improving the technical capacity of the subject matter specialists, extension supervisors, and DAs through regular training.

2.8 The PADETES System:

The major policy framework for economic development of Ethiopia is currently the Agricultural Development Led Industrialization (ADLI), which was formulated in 1993. ADLI emphasizes that the economic performance of Ethiopia, to a large extent, depends on the commercialisation of smallholder farmers as well as enhanced growth in the rural areas. To bring the objectives of ADLI into practice, the new extension system known as Participatory Demonstration and Training Extension System (PADETES) was developed in 1995 after critical evaluation of the past extension approaches and capitalizing on the experiences of the SG-2000 program. Among the major objectives of PADETES were: a) Increasing production and productivity of small-scale farmers through research generated technologies and information; b) Empowering farmers to participate actively in the development process; c) Increasing the level of food self-sufficiency. Based on these objectives, the National Extension Intervention Program (NEIP) was implemented in almost all the regional states. The NEIP mainly focused on rendering extension service and technology dissemination based on agro-ecology. The system gives special consideration to the package approach in agricultural development and as a result several extension packages were prepared and promoted. However, the effectiveness and the strategies of package formulation at the federal level need to be assessed critically at regular intervals with the objective of improving them.

3. The EMTP of SG 2000 Experience in Ethiopia

The Sasakawa Global 2000 (SG 2000) program started its activities in Ethiopia in 1993 with the main aim of increasing agricultural food production at the level of small-scale farmers and stimulating the linkage between research and extension. SG 2000 initially used the Extension Management Training Plot (EMTP) on relatively large plots, often half-hectare on-farm demonstration plots.

The SG 2000 EMTP plots strategy contained the following main components:

- Improved seed with the appropriate seed dressing
- Recommended agronomic practices
- Recommended fertilizer use
- Proper crop protection practices
- Credit for the purchase of inputs
- Training – for development agents (DAs) and farmers
- Close follow up of the EMTPs by DAs

4. Weak Linkage Between Research, Extension, and Technology Users

Agriculture in Ethiopia is dominated by traditional and subsistence farming which include the use of backward traditional farm tools and farming practices, low application of modern inputs such as improved seeds and fertilizers, lack of improved animal breeds, and lack of efficient livestock disease management techniques. Technical information on these and related topics must be obtained from the national research system, but

unfortunately, the linkage between research and extension in Ethiopia has been historically weak. Weak linkage between research, extension, and technology users is one of the critical factors that have hindered the forward movement of agricultural productivity and production in Ethiopia. This weakness stems partially from the absence of sound linkage policies in the agricultural knowledge generation and information transmission systems that do not appropriately respond to the needs of farmers.

Among other things, weak linkage entails**:**

- Disruption in the technology flow process
- Low adoption rates
- Increased time lag between development and adoption
- Reduced efficiency in the use of resources
- Unnecessary competition and duplication of efforts
- Increased cost of research and extension activities
- Confusion among farmers regarding which organization (institution) to approach

5. Linkage Mechanisms

It is imperative to consider both the structural and the functional mechanisms of linkage when one examines how research and extension work together to serve the end users of technologies. Each aspect is essential for strengthening the research and extension linkage in the country.

Structural or organizational mechanisms:

One strategy for streamlining and organizationally forcing research and extension to work together is to combine the two units into one entity and have them report to a common leadership and occupy the same physical compound. The primary advantage of this alternative is that the two units will be forced to interact and exchange information on a regular basis and provide a more efficient service to the end users of technology. Another strategy is to designate extension liaison positions in research centers and research liaison positions in woreda or zonal Agriculture and Rural Development Offices, with full time responsibility for addressing and implementing research and extension linkage. Yet another approach is to create inter-institutional committees or councils with the responsibility to oversee and ensure that research and extension linkage functions are carried out efficiently and properly for the benefit of farmers. Developing inter-institutional agreements for collaboration could strengthen these inter-institutional linkage mechanisms.

Functional linkage mechanisms:

Keeping the current structural mechanisms of linkage between research and extension, one could redefine the job descriptions of the appropriate personnel in

research and extension to strengthen their functional relationships. Establishing joint responsibilities for situation analysis, problem identification, adaptive research and on-farm technology demonstrations, reviewing research and extension activities, and impact assessment could contribute to strengthening the functional linkage of research and extension. Joint training on the expanded and mutual roles of the technology generation and transfer system could also be useful. Furthermore, exchanging personnel between the two entities such as posting extension staff to a research center and assigning researchers to a Woreda Office of Agriculture and Rural Development (WOARD) office where they would be actively involved in technology transfer activities jointly with WOARD personnel.

6. AMAREW's Approaches to Strengthening Research-Extension-Farmer Linkage

The AMAREW Project has been emphasizing integrating the five main components of its activity, which are research, extension, watershed management, capacity building, and micro-enterprise development. With the devolution of power for development to the woreda level, developing plans and implementing programs are now centered at the woredas, which are semi-autonomous in the administration and management of their human, material and financial resources. Hence, AMAREW has been making concrete efforts to engage all components of the project at the level of each pilot woreda. AMAREW has used multi-pronged approaches to strengthen Research-Extension-Farmer Linkages in the ANRS. Among these are Pilot Woredas Extension Model, On-farm Research Model, Farmers-Researchers-Extension-Groups (FREGs), Integrated Watershed Management, and Paradigm Shift Advocacy.

6.1 Extension Planning:

AMAREW assists its ANRS partners in forging a functional link between extension staff and researchers through joint planning, implementation, monitoring and evaluation, technical advice, very close follow-up of planned activities, technology supply, and capacity building. Through woreda level joint research-extension-farmer planning workshops, representatives from the woreda agricultural offices in our extension target woredas meet annually and review the Project's extension and on-farm research plans of their respective woredas and research centers. This facilitates building a working multi-disciplinary team of extension workers and researchers at the Woreda level. The annual research-extension planning workshops provide opportunities for extension agents to be exposed to available technologies in the research centers and to report major problems of their respective areas so that they will be a part of the future research agenda. In order to coordinate on-farm research activities, a woreda level Research-Extension Technical Committee (RETC) has been envisioned. With the support of AMAREW, efforts are underway to convince ARARI and BoARD decision makers to accept RETC as part of the regular government activity. The RETC should ideally be composed of two members from the Woreda Office of Agriculture and Rural Development (WoARD) and two from the respective research center, with the Deputy Head of WoARD serving as the chair and convener.

6.2 On-farm Research Joint Planning:

AMAREW also fosters a close cooperation and integration of research and extension in on-farm research activities in its mandate areas. This functional integration involves jointly planning and implementing of on-farm activities by research and extension. The

needs and priorities of the farming communities can be addressed through such integrated approaches. Planning workshops bring together research and extension staff not only to review on-going research activities but also to jointly plan and share responsibilities in implementing on-farm research and extension activities in the pilot woredas. In the conduct of on-farm research, for instance, site and farmer selection is made the responsibility of research and extension jointly, while land preparation, planting, data collection of demonstration trials are the responsibilities of extension with training and other assistance provided by the research center. Research takes normally the lead in planning and implementing on-farm trials with extension playing the critical collaborative role. Farmers assume appropriate responsibilities in selected activities.

The integration of on-farm research and pre-extension trials, technology transfer, and watershed management activities addressed by the AMAREW project are demonstrated through popularization of improved technologies at our pilot extension woredas, seed multiplication at the center sites and farmers' fields, as well as integrated activities at our pilot watersheds. The selection of participating farm households, trial sites, and execution of on-farm verification and demonstration in each target woreda have been conducted with the full participation of researchers, woreda development agents (DAs), and the local farmers.

6.3 FREGs:

ARARI research centers have been handling with the support of the AMAREW Project a number of on-farm trials in the targeted food-insecure and drought-prone woredas of the ANRS. The primary objective of the on-farm research is to generate improved and adaptable agricultural technologies in the areas of crops, livestock, and natural resources and enhance production and productivity, thereby contributing to solving the food security problem in the ANRS. On-farm research enhances the relevance of research by directly involving farmers in a participatory manner in developing and identifying new technologies.

Exemplary work is being done by some of the ARARI centers on research-extension-farmer linkage through Farmers' Research Extension Groups (FREGs), which have been formed in the mandate areas of each participating ARARI center with a focus on the important commodities of each area. The members of the FREGs range from 25 to 40 in number. They normally meet every month and make a tour of members' farms to share experiences and monitor the performances of the improved crop technologies.

6.4 Integrated Watershed Management:

In addition to the woreda level activities, strong and exemplary linkages are practiced at the level of AMAREW's pilot watersheds. AMAREW's two pilot watershed sites, Yeku in Sekota and Lenche Dima in Guba Lafto, are the two primary geographical sites for the integration of the various components of the Project. At these two pilot watersheds, all project components converge to run an integrated watershed management program to

address the Rural Household Production and Productivity increased Strategic Objective of the USAID/Ethiopia Mission. At the pilot watershed levels, researchers at Sirinka and Sekota Research Centers are involved in the conduct of trials in Lenche Dima and Yeku watersheds. Formal planning at both sites is conducted with most of the stakeholders present during the annual planning, and taking an active role in deciding on interventions. Planning is done for subsequent growing seasons to address more of the priority production and natural resources management problems and constraints identified by the watershed communities. The Community Watershed Management Organizations (CWMOs) established by AMAREW are playing major roles in institutionalizing the interaction of regional agencies and in leading and coordinating their activities at the watershed level.

6.5 Paradigm Shift:

AMAREW will continue to play an active advocacy role to promote an effective linkage between research, extension, and farmers in the ANRS. The major thrust of the Project is still to bring about a paradigm shift in participatory methodologies and foster close cooperation and functional integration of research and extension in on-farm research and technology transfer activities in the Project's mandate areas with the ultimate aim of improving agricultural productivity and income of farming households. The functional integration in AMAREW's approach involves jointly planning and implementing activities by different institutions for the benefit of the rural poor. The paradigm shift in strengthened research-extension linkage envisaged at the initiation of the AMAREW project is slowly taking hold at the pilot watersheds as researchers, extension agents, farmers, and AMAREW Project staff repeatedly participate in joint planning, program implementation, evaluation, monitoring, and applying results. The ultimate objective of AMAREW is to institutionalize the strengthened research-extension linkage and scale it up to a wider area in the ANRS.

6.6 Capacity Building:

AMAREW places high priority on capacity building at all levels, researchers, extension personnel, and farmers. The project provides opportunities for both long and short-term training for its partners. Research-Extension-Farmer linkage is enhanced through various types of appropriate training.

7. Conclusions and Way Forward

AMAREW will continue to work with its ANRS partners to strengthen linkage between all partners working to improve agricultural production and productivity in the ANRS. There is really no alternative to strengthening linkage between research, extension, and the farmer, if agricultural production and productivity in the ANRS are to increase as desired by all the concerned parties.

Based on the collective experience of its staff and the Project' multi-pronged strategies of promoting research, extension, and farmer linkage in the last three years, AMAREW believes that the only sustainable way to institutionalize research and extension linkage in the ANRS is to radically change the structural mechanism on how these two entities relate to each other. We propose the formation of a single institution called the Amhara Regional Institute of Agricultural Research and Extension (ARIARE) that will have the

overall responsibility for agricultural research and extension in the ANRS. Under this proposed ARIARE, all research and extension professionals in the ANRS are envisioned to come under a unified program reporting to the same leadership and management. Professionals under this arrangement may have full time research or extension appointments or partial research and extension appointments. In as much as possible, the physical working location for all research and extension personnel should be in the same compound.

Integrated Agricultural Development Strategies in the ANRS: Lessons from the AMAREW Project*

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Abstract

The Amhara Micro-enterprise development, Agricultural Research, Extension and Watershed management (AMAREW) Project is a USAID/Ethiopia Mission funded initiative established in July 2002 to provide technical assistance in integrated agricultural development in the Amhara National Regional State (ANRS). The Project works to strengthen agricultural research, extension, watershed management, capacity building, and micro-enterprise development in the ANRS by collaborating with its ANRS partners in strategically selected two pilot watershed sites and five pilot food-insecure woredas.

The Project is being implemented by a Virginia Tech led Consortium (Virginia Tech, Cornell University, Virginia State University and ACDI/VOCA) in collaboration with its ANRS Primary Partners consisting of the Food Security Coordination and Disaster Prevention Office (FSCDPO), Amhara Regional Agricultural Research Institute (ARARI), Bureau of Agriculture and Rural Development (BoARD), Environment Protection, Land Administration, and Utilization Authority (EPLAUA), Amhara Micro and Small Industries Development Bureau (AMSEIDB), and Amhara Credit and Saving Institution (ACSI). FSCDPO has the overall role of coordinating Project activities; ARARI is responsible for the planning and implementation of research; BoARD plans and implements agricultural extension and watershed management activities in the pilot extension woredas and watersheds; EPLAUA has the responsibility for guiding land use and certification in the pilot watersheds; AMSEIDB and ACSI share responsibilities for micro-enterprise and micro-finance issues in the target areas of the project. The technical advisors of AMAREW work with and advise their respective line department experts in all stages of project activities.

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AMAREW strives to catalyze a paradigm shift in the ANRS in strengthening research extension linkage where education, research, and extension are integrated similar to the service-oriented Land Grant University Model of the USA. The Project focuses on upgrading human resource capacities and reinforcing the institutional relations between ARARI and BoARD through joint planning and implementation of on-farm research and extension programs. Our five pilot extension woredas are planned to integrate research and extension, thereby demonstrating that effective linkage of extension and research are possible in the ANRS. Our two pilot watershed management sites (Lenche Dima in Guba Lafto and Yeku in Sekota) serve as models for integrating watershed management, research, extension, and micro-enterprise development efforts. In the long run, the promising experiences and lessons learned through the activities of the AMAREW Project should be scaled up to other sites in the ANRS as well as nationally, thus contributing to the alleviation of the food security problem of the region and the nation.

Background: Agriculture is the backbone of the Ethiopian economy. It is responsible for approximately 50% of the Gross Domestic Product, 90% of foreign exchange earnings, and 85% of the livelihoods of the population. Ethiopia's agricultural sector is driven by the subsistence strategies of smallholder farmers and their families. In the past, due to insufficient knowledge base, some misguided agricultural policies, coupled with a rapidly growing population, chronic poverty, and erratic rainfall, have caused severe food security challenges for farm families and natural resource degradation. Drastic new approaches that lead to improvement of food security and a lessening of the dependence on food aid are needed. Against this rationale, the Amhara National Regional State in its rural development strategy has included the need for a conservation based, watershed focused development approach regionally.

Objectives: One of the stated objectives of the AMAREW project is to assist the efforts of the ANRS to bring about a major change in the process of planning and implementing agricultural research and extension, in such a way that farmers and all stakeholders would play a pivotal role in defining the course of agricultural research and extension. Accordingly, the two pilot integrated watershed management areas are serving as sites for integrating research, extension, watershed management and micro-enterprise development efforts. Similarly, the five pilot extension woredas are serving as pilot woredas for functionally integrating research and extension at Woreda level. Briefly, AMAREW works to strengthen agricultural research and extension, watershed management capacity, and micro-enterprise development in the ANRS by working in targeted and selected pilot food-insecure woredas.

Over 50 percent of the 110 woredas of the ANRS are food-insecure. Poverty is widespread particularly in rural areas. Many households are only able to produce sufficient food to meet their food requirements for less than six months of the year. Agricultural production and productivity is generally very low. Land degradation, overgrazing, soil erosion, deforestation and cultivation of steep and fragile lands has resulted in the loss of productivity and biodiversity in the region. Although poverty is one of the defining characteristics of food insecurity in the region, it is exacerbated by inefficient agricultural practices, recurrent drought, inefficient access to land, and limited non- and off-farm income opportunities.

Production, productivity, and income of rural households in the region can be increased through the availability and proper use of agricultural technologies. Rural income can also be increased through participatory agricultural research, giving technology users an important say in technology development, and transforming a top-down, supply-driven technology transfer system to a bottom-up, demand-driven one.

Inspired by the service-oriented USA land-grant university model of integrated extension, research and education, AMAREW also promotes the adoption of peer-to-peer collaboration between Ethiopian and USA counterparts. Besides, AMAREW upgrades human resource capacities and reinforces the institutional relations between ARARI and BoA through joint planning and implementation of on-farm research and extension programs. AMAREW has been working with ACSI to establish a Management Information System for its banking services. It has been aiming also at working with the Amhara Micro and Small Enterprises and Industries Development Bureau (AMSEIDB,) to develop public and private sector Business Development Services practitioners at the woreda level.

The Virginia Tech led Consortium (Virginia Tech, Cornell University, Virginia State University, and ACDI/VOCA) implements the AMAREW Project. Project implementation started at the beginning of July 2002. A Kick-off Workshop was conducted on September 19 and 20 to announce the launching of the Project, and to introduce the project personnel, partners, and stakeholders to each other. During this workshop, the Virginia Tech Consortium and the then Primary Partners of the Consortium in the ANRS, namely Food Security Program Coordination Office (FSPCO), Amhara Regional Agricultural Research Institute (ARARI), Bureau of Agriculture (BoA), Amhara Credit and Saving Institution (ACSI), and the Regional Micro and Small Enterprises Development Agency (ReMSEDA, now MSEIDB, Micro and Small Industries Development Bureau) were all present. ARARI is responsible for the planning and implementation of research while BoA plans and implements agricultural extension and watershed development activities in the selected watersheds and pilot extension woredas, respectively. Similar arrangements govern AMAREW's relationships with other ANRS partners. The technical advisors of AMAREW advise and assist their respective line department experts in planning and follow up of activities. The experts are assigned not to plan and implement activities by their own but to advise and assist implementing institutions of the ANRS in the planning and monitoring processes. Accordingly, the annual work plan is designed and implemented by the concerned institutions of the ANRS.

Modalities of Implementation: The overall work of AMAREW is being coordinated and overseen by a Regional Implementation Team (RIT), chaired by the Head of the Food Security Coordination and Disaster Prevention Office (FSCDPO). The RIT meets regularly, at least once in three months to monitor project progress. The RIT members are Heads (or their representatives) of FSCDPO, ARARI, BoA, ACSI, AMSEIDB, EPLAUA, CPB, AMAREW, USAID, BoFED, and MoFED. Concerned institutions of the ANRS, in consultation with technical advisors of AMAREW, prepare their plans and reports and submit to the RIT. The RIT reviews and recommends plans and reports, before sending them to USAID-Ethiopia for approval. The RIT has also been actively involved in the selection and recruitment of locally hired project associate advisors. As a

result, the understanding by the project staff is that the concerned bureaus of the ANRS own AMAREW.

Integration of Project Components: The integration of on-farm research, extension, and watershed activities addressed by the AMAREW project are demonstrated through joint planning and implementation of pre-extension trials and popularization of improved technologies at our five pilot extension woredas, seed multiplication at the center sites and farmers' fields, as well as integrated activities at our two pilot watersheds. The selection of participating farm households, trial sites, and execution of on-farm verification and demonstration in each target woreda are conducted with the full participation of researchers, woreda extension staff (DAs), and the local farmers. At the pilot watershed levels, researchers at ARARI's Sirinka and Sekota Research Centers are involved in the joint planning and implementation in Lenche Dima and Sekota watersheds, respectively.

Research Component: One of the objectives of the AMAREW project is to build the capacity of ARARI to carry out on-farm research through a) strengthening the on-farm research program; and b) modernization and upgrading of the research facilities. AMAREW works with ARARI to strengthen its research program based on the Amhara Research Master Plan, and the Three-year Strategic Plan. The ARARI research centers have the mandate to serve the chronically food-insecure woredas in the region.

In the five pilot woredas, the research and extension components of the Project are integrating their activities both at the planning and the implementation phases. There is an understanding that farmers who have been taking trainings in some technical areas such as fishery, beekeeping and poultry have benefited in the areas of marketing, business development, credit and savings.

Research and Extension: The core objective of the research component of the AMAREW Project is to build the capacity of ARARI to carry out on-farm research through a) strengthening the on-farm research program in the target woredas of the Project b) upgrading of research facilities of the ARARI centers c) upgrading of researchers skills through long and short-term trainings.

Focus Woredas: The Project has been mandated to work on five selected pilot woredas for research and extension activities in order to enhance synergy and maximize activity integration in terms of technology generation and testing, information and technology dissemination, provision of resources, and market access. The list of the pilot woredas (by zone) selected for these interventions are given below in Table 1 for each Project component:

Table 1. Selected pilot target woredas by zone and major activity components of the AMAREW Project

Target Area	Research	Extension	Watershed Management	Safety Net Activities
Wag Hamra Zone				
Sekota Woreda	X	X	X	X
North Wello Zone				
Gubalafto Woreda	X	X	X	X
South Wello Zone				
Tehuledere Woreda	X	X		
South Gonder Zone				
Lay Gayint Woreda	X	X		
North Gonder Zone				
E. Belassa Woreda	X	X		

Technology generation and demonstration through on-farm research: ARARI research centers have been handling with the support of the AMAREW Project a number of on-farm trails in the targeted food-insecure and drought-prone woredas of the ANRS. The primary objective of the on-farm research is to generate improved and adaptable agricultural technologies in the areas of crops, livestock, and natural resources and enhance production and productivity, thereby contributing to solving the food security problem in the ANRS. On-farm research enhances the relevance of research by directly involving farmers in a participatory manner in developing and identifying new technologies. Technologies generated and/or demonstrated by the research centers employing this approach have been many and diverse. Some examples in crops research are improved varieties of wheat, barley, sorghum tef, faba bean, sesame, groundnut, cotton, and potato. Other examples of improved technologies are poultry breeds, different types of beehives, appropriate and improved farm implements, rope and washer pump, and drip irrigation.

Research and Development on *Vernonia:* *Vernonia galamensis* is a widely distributed weed in Eastern Africa, including Ethiopia, but a potential oil crop of industrial use such as plasticizers and paint additives. AMAREW works with ARARI's Adet Agricultural Research Center (AARC) and Sirinka Agricultural Research Center (SARC) to promote this potential export oil crop. For potential release by the National Variety Release Committee, the ARC has identified two high yielding *Vernonia* varieties. The

AMAREW project encourages and assists ARARI in strengthening national and international (particularly the USA) collaboration among *Vernonia* stakeholders.

Participatory seed multiplication: Shortage of seeds of improved varieties in adequate quantity is one of the major problems faced by farmers in the target woredas. Without the provision of adequate seeds, released varieties by themselves do not bring about the needed food security to farmers. In response to the dire need of farmers in the target woredas, the Adet and Sirinka Research Centers have been engaged in seed multiplication of improved varieties of field and horticultural crops on farmers' plots through participatory seed multiplication.

Tissue Culture Laboratory: To assist the ARARI efforts of upgrading and modernizing its laboratories, AMAREW has actively assisted the institute in equipping and strengthening its tissue culture laboratory at the Adet Research Center. Among other things, the tissue culture laboratory will assist in rapid potato seed multiplication. Released potato varieties by ARARI Research Centers could not reach farmers in adequate quantity and quality due to the lack of rapid potato seed multiplication facilities.

The Small Grant and Mentorship Program (SGMP): The purpose of the SGMP is to establish a collaborative linkage between young researchers of ARARI and BoARD with senior scientists in the Collaborative Research Support Program (CRSP) universities of the USA and encourage young researchers to develop and implement sound research projects with the associated element of professional competition. In response to the call for proposals AMAREW issued, a number of researchers of ARARI and BoARD submitted research proposals some of which have been funded and are being implemented.

Research and Extension Linkage: The paradigm shift in strengthened research-extension linkage envisaged at the initiation of the AMAREW project is slowly taking hold at the pilot watersheds as researchers, extension agents, farmers, and AMAREW Project staff repeatedly participate in joint planning, program implementation, evaluation, monitoring, and applying results. The ultimate objective of the Project is to institutionalize the strengthened research-extension linkage and scale it up to wider areas in the ANRS.

The most potential for a strong and exemplary linkage is at the level of the two pilot watersheds. The two pilot watershed sites, Yeku in Sekota and Lenche Dima in Guba Lafto primarily are the geographical sites for the integration of the various components of the AMAREW Project. At these two pilot watersheds, the project components (research and extension) converge to run an integrated watershed management program. Formal planning at both sites is conducted with most of the partners present during the annual planning, and taking an active role in deciding on interventions. Implementation requires also interaction and linkage.

AMAREW project fosters a close cooperation and integration of research and extension in on-farm activities in its mandate areas. The functional integration involves jointly

planning and implementing activities by research and extension. The needs and priorities of the farming communities can be addressed through integrated approach and a strong research-extension linkage. The first level of integration of research and extension activities is focused on the woreda level. AMAREW is making concrete efforts to engage all components of the project at the level of each target woreda. Through Woreda level joint research-extension planning workshops, representatives from the Woreda Agricultural offices meet and review the on-farm research plans of their local research centers. These workshops bring together research and extension staff not only to review on-going research activities but also to jointly plan and share responsibilities in implementing on-farm research and extension activities in the pilot woredas. In the conduct of on-farm research, for instance, site and farmer selection is made the responsibility of research and extension jointly, while land preparation, planting, data collection of demonstration trials are the responsibilities of extension with training and other assistance provided by the research center. Research takes normally the lead in planning and implementing on-farm trials with extension playing the critical collaborative role. The annual research-extension planning workshops provide opportunities for extension agents to be exposed to available technologies in the research centers and to report major problems of their respective areas so that they will be a part of the future research agenda. In order to coordinate on-farm research activities, a woreda level Research-Extension Technical Committee (RETC) is operationally active. The RETC is composed of two members from the Woreda Office of Agriculture and Rural Development (WoARD) and two from the respective research center, with the Deputy Head of WoARD as the chair.

Exemplary work is also being done by some of the ARARI centers on research-extension-farmer linkage. For instance, several Farmers' Research Extension Groups (FREGs) have been formed in the mandate areas of each participating ARARI center with a focus on the important commodities of each area. The members of the FREGs range from 25 to 40 in number. They normally meet every month and make a tour of members' farms to share experiences and monitor the performances of the improved crop technologies.

Watershed Development Component

Project conceptualization: As the ANRS is a big region, it was decided to utilize a "learning lab" methodology, based on application of integrated watershed management activities in few selected watersheds. Accordingly four pilot watersheds namely Lenche Dima, Yeku, Gumet and Gemenkura sites in the ANRS were identified initially for potential USAID project activities. Initial feasibility study was prepared for the first two areas in May 1999, followed by more detailed the project proposal. Conventional methods and Participatory Rural Appraisal (PRA) as a tool were used depending on the nature of the information to be collected. The major tools and the information are social and resource mapping, air photo interpretation, base map preparation, problem analysis group discussions, transect walk, seasonal calendar, bar graphs, pair wise ranking, semi-structured interviews and participatory planning.

Watersheds development objectives

The AMAREW project watershed management component is designed to demonstrate integrative approaches to research, extension, community development, and micro-enterprise development in the two pilot watersheds (Yeku in Sekota woreda and Lenche Dima in Guba Lafto woreda). Major objectives include:

a) To reduce the current level of land and water resources degradation caused by soil erosion, overgrazing, and deforestation;
b) To reduce the current shortage of livestock feed and increase livestock production and productivity;
c) To increase crop production by using *in situ* soil moisture conservation, improved crop varieties and integrated pest management; and
d) To promote improved and alternative policy and institutional approaches through research and demonstrational trials.

Projects setting: The pilot project areas are in the drought-prone woredas of Gubalafto and Sekota. A crop-livestock integrated farming system prevails, with very low productivity. Yeku watershed is located in the Sekota Woreda, (20 Km South of Sekota town), Waghamra zone while Lenche Dima (20 Km East of Woldiya town) is in the Gubalafto Woreda, North Wello zone. Mean annual rainfall amounts are sufficient for most types of agriculture provided appropriate water conservation measures are in place. Temperatures remain relatively cool due to the high elevations. Most of the cultivated soils are deep but degraded and hard to manage due to high erosion hazard, low infiltration rates, low fertility, and physical hardness. Land holdings per household are small (0.75 ha) because of the high population density (> 100 inhabitants km^{-2}). The large livestock population also exerts considerable pressure on the land. A vast majority of the inhabitants in both watersheds are subsistence farmers. There are no significant industries in either area. The Lenche Dima watershed is close to a major highway linking Addis Ababa and Mekele while Sekota is farther away from the main road and easy access to markets. The above features are quite representative of most of the watersheds within the eastern drought prone region of the ANRS.

Major watershed problems: The main problems identified by stakeholders in the watersheds were drought, scarcity of water both for humans and livestock, soil erosion, deforestation, low crop productivity, crop pests and diseases, weeds, wild animals, shortage of oxen power, human and livestock health problems and diseases, cash shortage, inadequate access to markets, lack of good roads, and shortage of wood for fuel and construction.

Implementation approach: As part of a strategy to achieve food security, while protecting the environment through sustainable land use development, an integrated watershed management (IWM) approach to development has been identified by the region as a key development strategy. The major advantages of the IWM approach are involvement of the farmers in all phases of the development continuum of their watershed. Holistic planning that addresses issues which extend across subject matter disciplines (biophysical, social, and economic sciences) and administrative boundaries (village, woreda etc.) is essential. The project follows the concept that the whole watershed management is "an all integrated, holistic problem solving strategy used to restore and maintain the physical, chemical, and biological integrity of the ecosystem, protect human health, and provide sustainable economic growth". It focuses on hydrologically defined drainage basins (watersheds) rather than on areas defined by administrative boundaries.

The watershed management approach chosen here is innovative and intends to mold democratic pragmatism (bottom up) within the existing administrative rationalism (top down) governmental structure. The underlying objective is the creation of local organizational space to the rural community and their empowerment in playing the lead role in the overall development program.

Implementation arrangement

Project implementation is the key responsibility of the local community at large and the Sekota and Gubalafto Woreda Agriculture and Rural Development Offices (WARDO). The AMAREW Project's major responsibility is the delivery of technical and advisory support in terms of technology identification, evaluation, and dissemination. With this understanding, the various activities in the pilot watersheds are outlined below:

Building local level institution: To encourage participation and ensure sustainability of the initiatives, Community Watershed Management Organizations (CWMOs) have been formed in each pilot watershed sites. Pilot watersheds were divided into cluster of villages and each village group was organized to select eight representatives for the CWMO. Thirty two farmers form the Community Watershed Management Organization with 1:1 male to female ratio. CWMO members elected seven executive committee members to lead the organization. Within the CWMO, the following four different committees for development have been formed: agriculture, natural resources, income generation, and social development. The CWMOs have the broad task of planning, implementing, and monitoring watershed management activities and resolving conflicts among their members. In terms of the support to improvement of the local organizations, the project aims at empowering the project's watershed communities in several ways, such as enhancing:

a) Consultation and collaboration between community organizations, woreda offices of agriculture and rural development, the local administration, and the project;
b) Communication and dialogue among village groups on issues of mutual interest;
c) Review and monitoring on-going activities and annual planning;
d) Management and implementation of environmental and natural resource protection activities;
e) Management and resolution of conflicts among community members.

The role of the AMAREW Project in all these activities is technical support and advice, as it doesn't play the role of a main implementer. The woreda office of agriculture / rural development and the Project merely have the supporting and technical backup role in the realization of the objectives set by the community. This approach helps in strengthening community based institutions and making them more sustainable and self-reliant.

Natural Resources management: Some of the interventions under the natural resources development and management sector include soil and water conservation on different land cover or uses (hillside, grazing land, and farm land), agro-forestry development (homestead planting, planting on bunds), gully rehabilitation, closed area management, aforestation, training farmers, etc.

Livestock development: Forage production, small ruminant husbandry, improved poultry production, apiculture, animal health improvement (training of community animal health workers, mobile health clinic service, etc.), grazing land management, and backyard forage development.

Crop production and protection development: The crop production and protection component focuses on the introduction of improved crop varieties with resistance to biotic and abiotic stresses, promotion of appropriate and improved farm tools and implements, use of moisture conservation practices, expansion of water harvesting technologies, introduction of irrigation practices (particularly drip irrigation), use of organic fertilizers through compost making, use of improved cultural practices for improved crop production, promotion of IPM methods to control pests, diseases, and weeds.

Initial Impacts of the Watershed Management Activities

The watershed development activities in the two pilot watersheds have finished essentially two years of operation. Expectation of significant impacts from watershed development initiatives, such as these ones, in a couple of years is not realistic. The project has given due consideration to the social aspect of development during its initial interventions and then move to the physical development aspects. Even though the project is at its early stage, the following signals of positive impacts can be observed:

Local Institutions Strengthened: Major task of the project in the first year was to establish and build the capacities and skills of Community Watershed Management Organizations (CWMOs) so that the members could be empowered to assume responsibility for further resource conservation. To achieve this goal, the project organized and implemented diverse types of trainings and workshops such as Community Organization Leadership Towards Action (COLTA), organization of watershed communities, leadership skills, and conflict management trainings. At present, the CWMOs have reached a stage where they can handle the watershed development efforts by themselves with little external support.

Soil Erosion Reduced: The problem of soil erosion and the associated crop yield reduction was identified as one of the major problems in the pilot watersheds. Physical and biological soil and water conservation works in the watersheds have been going on for several years with non-significant results. With the CWMOs taking ownership and playing the lead role of the overall development program, all community done conservation works were properly protected and maintained ultimately resulting in reduced soil erosion. In the last two years alone, forest development and user groups are managing over 200 hectares of closed areas.

Ground Water Recharge Improved: Yeku watershed in the past was categorized as an area with poor ground water potential. Some of the seasonal streams usually dry up shortly after the main rain, as early as the December-November period. After the establishment of an area closure site and construction of different physical conservation works for soil and water, such as trenches, hillside terraces, and check dams, one of the seasonal streams which crosses the closure hill side has water flow until the end of January. It was also made possible to get water from shallow hand dug wells at a depth of less than 10 meters.

Harvested Water Utilized: Rainwater harvesting is currently a high priority at national and regional levels and this Project is well on its way to contribute in a significant way

within its pilot watersheds also. Although the number of constructed water harvesting structures are limited, those farmers who have constructed these structures have started production of vegetables and fruit trees. There is presently an increasing interest from the community in expanding these activities. To maximize crop production per unit volume of water, the project is working with the ARARI Centers in the introduction of rope and washer pump and drip irrigation technologies.

Crop Productivity and Diversification Increased: Erratic rainfall, accompanied by unpredictable seasonal variation, is a major characteristic of the rainfall pattern in the pilot watershed areas. As is common for most lowland areas of the country, rainfall is very poorly distributed within the rainy season; often there is too much water during a few days of the year, while water supply is inadequate during most of the crop-growing period. With the introduction of early maturing improved crop varieties, mostly released by research centers, farmers have indicated that they have started getting better yields. In addition, new crops such as sesame, groundnut, cotton, and triticale are being introduced and are showing promising results. In order to diversify production, those households that have constructed water-harvesting structures are being encouraged to grow horticultural crops such as onion, potato, tomato, pepper, cabbages, mango, papaya, and avocado.

Fodder Production Improved and Area Closure Accepted: Livestock production is an integral part of the agricultural setting in the pilot watersheds as is the case in similar ecosystems in the country in general. With the increasing trend of the numbers of livestock and humans associated with the decreasing size of grazing land, livestock productivity is significantly decreasing. The situation analyses in the pilot watersheds have clearly revealed that livestock feed shortage is one major constraint of the community. The introduction of closed area management, backyard forage development, planting or direct sowing of forage species on bunds, etc. have all increased fodder availability.

Off-farm Income Generation and Diversification Promising: Self-help groups (SHG) are being organized in the pilot watersheds to be engaged on small-scale off-farm income generating activities.

Promising examples under this section are:

a) A women's improved stove producers SHG at Yeku pilot watershed has reached a stage of being transformed to cooperative;
b) Another woman's SHG in the production of gabion box is under organization at Lenche Dima watershed;
c) Hundreds of poor households were enabled to participate in small ruminant husbandry and improved poultry production;
d) Modern honey production using improved hives and systems have been introduced to large numbers of households.

Most of these interventions have targeted mostly poor households and women.

Social Equity Promoted: Although landowners are the main participants in the project, the landless poor and marginal farmers have not been neglected either. Women were made major development actors in the watershed development. Fifty percent of the CWMOs members are women. Most of the income generating activities target poor

women. Closed area managing SHG are mostly landless or those with very small land holding.

Nutrition and Home Management Improved: Training on home management, nutrition, HIV/AIDS, and family planning are being given mainly to women. Subsequent to such training, women have started using contraceptives and have started discussion openly with their husbands in areas of HIV/AIDS and the need for family planning, which was not usually done in the past. As a result of the training on nutrition and home management, farmers have recently started consuming vegetables more frequently.

Lessons Learned

Community level organizations can potentially serve as focal points for efforts to resolve local disputes and mobilize farmers to collective and constructive action. However, watershed development projects in the past have focused mainly on the technical aspects with little attention given to the social issues and sustainability of the initiated interventions. The food aid operation, which has been going in most parts of northern Ethiopia, mainly in Wello, has created deep-rooted dependency syndrome where farmers are unwilling to contribute free labor in the overall watershed development. In the short-term, it appears difficult to remove or greatly reduce the present reality of aid dependency syndrome. However, our Project's experience reveals that in selected communities there are very encouraging signs of farmers' willingness to contribute free labor for community development. For instance, farmers at Yeku watershed who were very resistant to contribute free labor at the beginning of the project have reached a stage of 40% free labor contribution at the present moment. This was mainly the result of closely involving the watershed community, in a participatory mode, in the overall development ventures and by following a "demand-driven" rather than a "supply-driven" approach in the watershed development.

Institutional stability and persistent follow up is a key factor for sustainable watershed management projects. Equally important is the institutional strength to deliver the appropriate support services on time. We have witnessed repeated institutional restructuring and alarming levels of staff turnover within the agriculture and rural development sector. Such levels of institutional restructuring and staff turnover greatly affect negatively the smooth and uninterrupted implementation of watershed activities.

Selection of technologies has to be done with the full participation of local communities. Technologies generated by research centers and introduced to farmers have to be appropriate and affordable to farmers. Such an approach will put the farmers first, as they participate in choosing the technology they need. Without meaningful participatory involvement of farmers at all stages, watershed activities can neither be embraced by farmers nor be sustainable. In this regard, the farmers-research-extension groups (FREG) established in the pilot watersheds have been found to be very effective tools.

Participatory planning is not an "open" exercise in that all parties involved have their own agendas. The challenge is to define and develop a common position, which should be open for the inclusion of activities identified in response to immediate needs of the stakeholders

Community Watershed Management Organizations (CWMOs) established in the two watersheds (Yeku and Lenche Dima) have already begun playing lead roles in influencing the direction of research and extension in the watershed areas. As a result, implementation of community-determined soil and water conservation interventions as well as other watershed development activities are underway.

Area closures in the two watersheds have become social closures with no armed guards or fences, but only by an agreement reached among the community members to exclude animals from the protected closures and to avoid cutting of vegetation. The results to date are encouraging and in some cases impressive. Concerned regional officials have visited these areas at repeated occasions and have recognized them as promising and exemplary activities to be scaled up in similar situations elsewhere in the ANRS.

Human capacity building experience of the AMAREW Project

Through the different components of the AMAREW Project, development and dissemination of new technologies that could be used in improving the production and productivity of crops and livestock, as well as managing the natural resources are being implemented in the selected areas of the mandate woredas of the ARARI research centers, the five pilot extension woredas, and the two established pilot watersheds. Obviously, for these new technologies to be adopted, people who are supposed to implement the technologies should have the required knowledge, skill and positive attitude. This includes people involved at all levels of the technology development and dissemination process. Woreda experts also have to be equipped with the necessary knowledge and skill about the technologies that they are disseminating as well as alternative methods of technology transfer. Similarly, researchers require knowledge that would help them to be effective and efficient in developing appropriate technologies. Furthermore, farmers should have clear understanding about the technologies and skills that would help them improve their productivity and household income. In addition, they also require knowledge and skill that will help them to judiciously manage their natural resources.

The recent decentralization making the woreda the functional unit of development has placed heavy responsibility on the shoulders of the staff of the woreda agricultural and rural development offices on a broad range of technical issues. Often the staff that carries this responsibility is neither sufficient in number nor adequately prepared to carry through the required task. Due to this, building the analytical, operational, and management capacity of partner institutions and farmers within the context of the strengthened research and extension services were considered as key areas requiring the project support.

The human capacity building activities were selected based on the needs of partner organizations. Furthermore, as outlined in Fig.1 below, the different human capacity building interventions focus on imparting knowledge and skill across the involvement areas of the AMAREW Project. Capacity building targets crop and livestock production, natural resource management, community organization, and leadership both through long and short-term training activities. The ultimate goal is to strengthen and reinforce the project's component based interventions in research, extension, and watershed management.

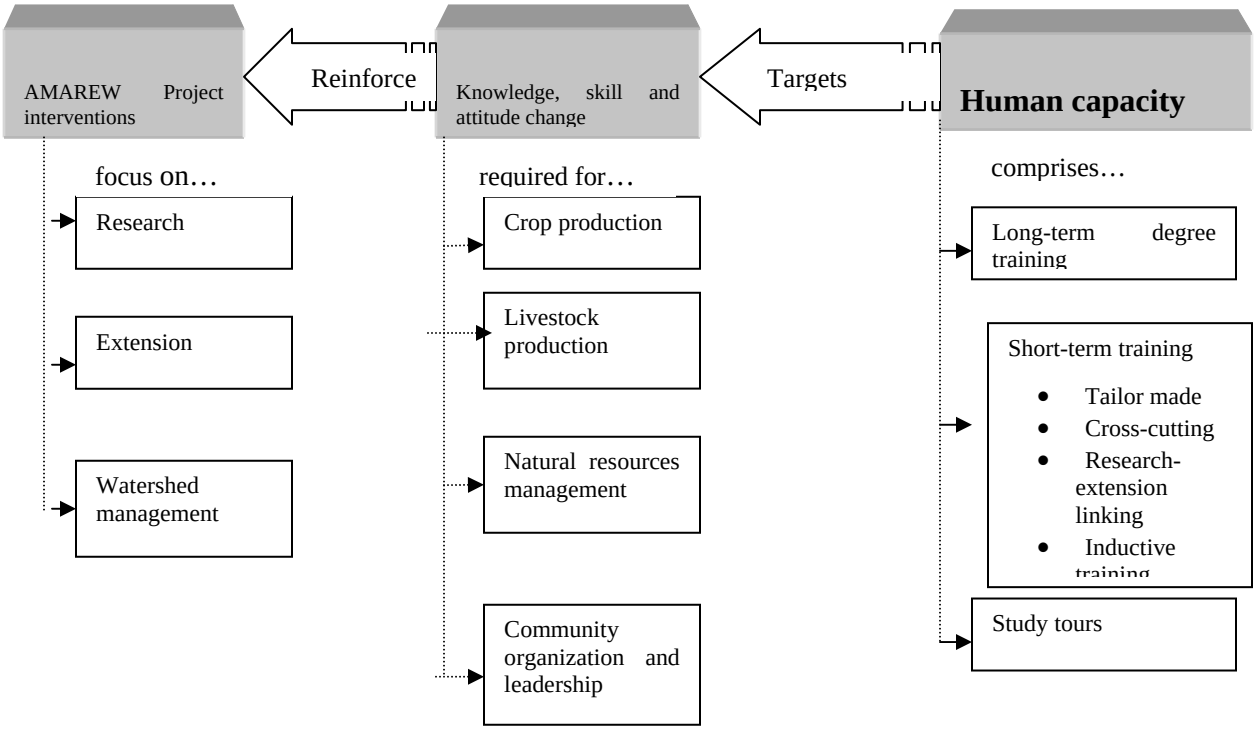

Fig.1. Framework for implementing the AMAREW Project's capacity building activities

Annex Table 1- Plan vs Accomplishment of the extension component on activities related to crop production
Dissemination of improved crop varieties in 2007

No	Crop	Varietry	Unit	Pilot Woreda												
				East Belessa		Lay Gayint		Sekota		Guba Lafto		Tehuledere		Total		
				P	A	P	A	P	A	P	A	P	A	P	A	
1	**Cereals**			**23.1**	**41.4**	**96**	**60**	**69**	**76**	**77**	**76**	**46**	**68**	**311**	**319**	**102.8**
1.1	**Tef total**			**20.25**	**40**	**0**	**0**	**13.5**	**12**	**10.3**	**6.5**	**13.5**	**5**	**57.55**	**63.5**	**110.3**
1.1	Teff	DZ-01-196		6.75	10	0	0	13.5	0	10.3	6.5	13.5	5	44.05	21.5	48.8
		Dz-01-974		6.75	0	0	0	0	0	0	0	0	0	6.75	0	0.0
		Cr-37		6.75	30	0	0	0	12	0	0	0	0	6.75	42	622.2
1.2	**Wheat total**			**0**	**0**	**67.4**	**60**	**50.7**	**64**	**67**	**69**	**32.7**	**52.9**	**217.8**	**245.9**	**112.9**
1.2	Wheat	HAR-1685		0	0	0	60	50.7	64	67	68	32.7	0	150.4	192	**127.7**
		Laste		0	0	0	0	0	0	0	1	0	0	0	1	
		HAR-1668		0	0	16.9	0	0	0	0	0	0	52.9	16.9	52.9	**313.0**
		HAR-604		0	0	50.5	0	0	0	0	0	0	0	50.5	0	**0.0**
1.3	**Barley total**			**0**	**0**	**28.2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**28.2**	**0**	**0.0**
1.3	Barley	Mulunesh		0	0	14.1	0	0	0	0	0	0	0	14.1	0	**0.0**
		Shedeho		0	0	14.1	0	0	0	0	0	0	0	14.1		**0.0**
1.4	**Fingure millet total**			**1.8**	**1.43**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1.8**	**0**	**0.0**
1.4	Fingure millet	Taddesse		0.9	0.72	0	0	0	0	0	0	0	0	0.9	0.72	**80.0**
		Padet		0.9	0.71	0	0	0	0	0	0	0	0	0.9	0.71	**78.9**
1.5	**Sorghum total**			**1**	**0**	**0**	**0**	**4.5**	**0**	**0**	**0**	**0**	**5**	**5.5**	**5**	**90.9**
1.5	Sorghum	Abshir		0	0	0	0	4.5	0	0	0	0	0	4.5	0	**0.0**
		Meko		0.5	0	0	0	0	0	0	0	0	0	0.5	0	**0.0**
		Teshale		0.5	0	0	0	0	0	0	0	0	0	0.5	0	**0.0**
1.6	**Maiz**	**BH-540/660**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**5**	
2	**Pulses**			**90**	**10**	**98**	**96**	**5**	**2.5**	**20**	**20**	**45**	**0**	**258**	**129**	**49.8**

2.1	Chick pea	Mariye		90	10	0	0	0	0	0	0	22.5	0	112.5	10	**8.9**
2.2	**Faba bean total**			**0**	**0**	**98.4**	**96**	**0**	**0**	**19.7**	**20**	**0**	**0**	**118.1**	**116**	**98.2**
2.2	Faba bean	CS-20-DK		0	0	59	90	0	0	19.7	0	0	0	78.7	90	**114.4**
		Bulga		0	0	0	0	0	0	0	20	0	0	0	20	
		Degaga		0	0	39.4	0	0	0	0	0	0	0	39.4	0	**0.0**
2.3	Haricot bean	Awash Melka		0	0	0	0	4.7	2.5	0	0	22.5	0	27.2	2.5	**9.2**
3	Vegetables			0	0	0	0	0	0	0	0	0	0	0	0	
3.1	Potato total			0	0	75	148	0	0	75	75	0	0	150	222.8	**148.5**
3.1	Potato	Menagesha		0	0	75	0	0	0	75	0	0	0	150	0	0.0
		Wochecha		0	0	0	27.8	0	0	0	0	0	0	0	27.8	
		Jalene		0	0	0	115	0	0	0	60	0	0	0	175	
		Gudina		0	0	0	0	0	0	0	10	0	0	0	10	
		Guassa		0	0	0	0	0	0	0	5	0	0	0	5	
		Digemegn		0	0	0	5	0	0	0	0	0	0	0	5	
3.2	Vegetable seed in(Kg)			8.8	0	49.7	59	20.9	0	45.78	0	71.6	0	196.8	59	**30.0**
	Cabbage			0.4	0	1.1	15	0.5	0	1.08	0	1.44	0	4.52	15	**331.9**
	Carrot			5.4	0	16.2	16	7.2	0	21.6	0	32.4	0	82.8	16	**19.3**
	Beet root			0	0	28.8	28	9.6	0	19.2	0	28.8	0	86.4	28	**32.4**
	Lettuce			0	0	0	0	0	0	2.7	0	3.6	0	6.3	0	**0.0**
	Peper			3	0	3.6	0	3.6	0	1.2	0	5.4	0	16.8	0	**0.0**
3.3	Garlic and Shallot total			14.4	0	20.4	0	0	0	7.2	0	10.8	0	52.8	0	**0.0**
3.1	Garlic			7.2	0	9.6	0	0	0	0	0	0	0	16.8	0	**0.0**
3.1	Shallot			7.2	0	10.8	0	0	0	7.2	0	10.8	0	36	0	**0.0**
4	Fruit total			450	254	450	500	0	0	450	500	450	0	1800	1254	**69.7**
4.1	Highland fruit tree seedlings			0	0	450	500	0	0	450	500	0	0	900	1000	**111.1**
4.4	Avocado and Mango seedling			450	254	0	0	0	0	0	0	450	0	900	254	**28.2**

Annex Table 2- Performance of the extension component through dissemination of improved seed in number of varieties planned and achieved.

Crop	Number of varieties planned and implemented over 2003-2004												
	2003		2004		2005		2006		2007		Total		
	Plan	Achmt	Plan	Achmt	Plan	Achmt	Plan	Achmt	Plan	Achmt	Plan	Achmt	Achmt%
Cereals	4	4	18	19	18	6	17	11	13	8	31	30	97
Pulses	0	0	4	6	5	5	4	4	4	4	8	10	125
Oil seeds	0	0	1	1	1	0	1	0	0	0	1	1	100
Poteto	1	1	1	1	2	0	3	0	2	6	1	1	100
Sweet potato cuttings	1	1	1	1	1	1	1	1	0	0	1	1	100
Garlic and shallot	2	2	2	2	1	1	1	1	2	2	2	2	100
Other vegetables	5	6	9	6	8	6	9	6	9	7	9	9	100
Fruit seedlings"000"	4	4	5	3	5	3	0	3	5	7	5		0
Coffee"000"	1	1	0	0	0	0	3	0	0	0	1	1	100
Cassava/Pine apple succers"000"	1	1	0	0	0	0	1	1	0	0	1	1	100

Annex Table 3 - Types of crop varieties disseminated, 2003-2007

Physical Year	Crop species										
	Teff	**Wheat**	**Barely**	**Fingure millet**	**Triticale**	**Maiz**	**Sorghum**	**Chick pea**	**Fava beab**	**Haricot bean**	**Potato**
2003					Sinan, Minute	Katumani	Abshir				
2004	Dz-01-196, Dz-01-974, Xr-37	HAR-1685, HAR-1668, HAR-2501, HAR-2508, HAR-1522, K-6295	Abayi		Sinan, Minute	Katumani	Gambella-1167, Gobiye, Abs hir, Brhan, Teshale, Yeju, Meko	Mariye	CS-20-DK	MAM-41, Awash-1, Roba-1	Tolcha
2005	Dz-01-196, Dz-01-974, Xr-37	HAR-1685, HAR-1522,			Minut	Katumani, BH-542		Mariye, Arerti, Shasho	CS-20-DK, Holleta	Awashmelka	
2006	Dz-01-196, Dz-01-44, Dz-01-99 Xr-37	HAR-1685, HAR-1508, HAR-1668' HAR-604,				Katumai, Awassa-511	Abshir, Brhan	Mariye	CS-20-DK	Awashmelka	
2007	Dz-01-196, Dz-01-974, Xr-37	HAR-1685, HAR-1668, HAR-604, Laste Gerado		Taddesse, Padet,		BH-540/660		Mariye	CS-20-DK, Bulga	Awashmelka	Wochecha, Jalene, Gudina, Guassa, Digemegn
Total no. of varieties introduced	5	9	1	2	2	4	7	3	3	4	6

Annex Table 4 - Performance of the extension component in the amount of improved seed targeted and disseminated, 2003-2007

R.No	Crop	Unit	Year of operation												
			2003		2004		2005		2006		2007		Total		
			Plan	Achieved	Plan	Achieved	Plan	Achieved	Plan	Achieved	Plan	Achieved	Plan	Achieved	Achievement %
1	Cereals	Q	15.25	8.25	322	223	269	199	223	285	311	319	1140.3	1034	90.7
2	Pulses	Q	0	0	118	56	103	128.1	91	131	285	129	597	444.1	74.4
3	Oil seeds	Q	0	0	3	0.06	6	0	2	0	0	0	11	0.06	0.5
4	Poteto	Q	35	6	97	12	114	0	150	0	150	22.8	546	40.8	7.5
5	Sweet potato cuttings	"000"	160	160	412	1250	12	37	75	75	0	0	659	1522	231.0
6	Garlic and shallot	Q	2	5	30	5	35	0	55	0	52.8	0	174.8	10	5.7
7	Other vegetables	Kg	8	7	166.2	344	350	381.8	154.4	227	196.8	59	875.4	1019	116.4
9	Fruit seedlings	No.	129	129	28.15	31	1.6	8	0	1309	1800	1254	1958.8	2731	139.4
10	Coffee "000"	No.	28	28	0	0	0	0	0	0	0	0	28	28	100.0
11	Cassava /pine apple succers "000"	No.	1	1	0	0	0	0	3	0	0	0	4	1	25.0

Annex Table 5 - Plan vs Accomplishment of the extension component on activities related to livestock production

Livestock development technologies disseminated in 2007

No	Production branch	Breed	Unit	Pilot Woreda												
				East Belessa		Lay Gayint		Sekota		Guba Lafto		Tehuledere		Total		
				P	A	P	A	P	A	P	A	P	A	P	A	
1	Apiary		No													
1.1	Bee colony		No	60	31	30	0	79	77	60	0	59	0	288	108	37.5
1.2	Modern bee hive		No	30	31	30	30	60	77	30	0	60	0	210	138	65.7
1.4	Transitional bee hive		No	30	20	30	0	60		30	0	60	0	210	20	9.5
1.7	Protective gears	set	No	10	10	10	0	20	10	10	0	20	30	70	50	71.4
1.8	Working tools	set	No	10	10	10	0	20	6	10	0	20	30	70	46	65.7
1.9	WAX		Kg	112	96	90	0	180		180	0	180	180	742	276	37.2
1.11	Honey Extractor		No	1	0	1	1	1		1	0	1	2	5	3	60.0
1.12	Wax printer		No	1	0	1	0	1	1	1	0	1	1	5	2	40.0
2	Provisions of Small ruminants															
2.1	Sheep breed of Washera		No	0	0	265	0	210	0	340	66	386	180	1201	246	20.5
2.2	Goat breed of Abergele		No	0	0	0	0	180	0	0	0	0	0	180	0	0.0
2.3	Local goat for restocking		No	150	120	0	0	0		0	0	120	83	270	203	75.2
5	Forage production															
5.1	Forage seed		Q	3.83	0	8.33	0	4.74	10.82	5.18	1.05	4.06	0	26.14	11.87	45.4

Annex Table 6 - Performance of the extension component through dissemination of livestock technology, 2004- 2007

No	Production branch	Breed/ model/ type	Unit	Physical Year										
				2004		2005		2006		2007		Total		
				Plan	Achmt.	Plan	Achmt.	Plan	Achmt.	Plan	Achmt.	Plan	Achmt.	Achmt. %
I	**Poultry**													
1	Provision of day old chicks	white leg horn	No	6893	0	7250	2500	12780	0	0	0	26923	2500	9.3
2	Provision of three month pullet	white leg horn	No	660	0	0	140	600	0	0	0	1260	140	11.1
3	Provision of haybox brooder	Solom hay box brooder	No	170	35	155	0	104	72	0	0	429	107	24.9
II	**Apiary**		No											
1	Bee colony		No	150	0	370	0	460	87	288	108	1268	195	15.4
2	Modern bee hive		No	0	134	0	115	60	30	210	138	270	417	154.4
3	Transitory bee hive		No	0	0	120	140	60	60	210	20	390	220	56.4
4	Kenyan top bar bee hive		No	180	88	50	0	0	0			230	88	38.3
5	Queen Excluder		No	0	290	50	0	75	0			125	290	232.0
6	Top bar		No	16100	16592	9000	0	10150	0			35250	16592	47.1
7	Protective gears	set	No	40	10	60	30	60	60	70	50	230	150	65.2
8	Working tools	set	No	35	36	40	15	80	80	70	46	225	177	78.7
9	WAX		kg	50	400	85	602.5	400	1054	742	276	1277	2332.5	182.7
10	Honey Extractor		No	2	0	0	0	0	0	5	3	7	3	42.9
11	Wax printer		No	0	0	0	0	1	1	5	2	6	3	50.0
III	**Small ruminants**													
1	Sheep breed	Washera	No	5	0	15	207	390	90	1201	246	1611	543	33.7
2	Goat breed	Abergele	No	0	0	75	9	230	614	180	0	485	623	128.5
3	Goat for restocking	Local	No	0	0			150	100	270	203	420	303	72.1
IV	**Forage production**			0	0									
1	Forage seed		Q	24	103	136.2	13.4	58	0	26.14	11.84	244.34	128.24	52.5
2	Back yard forage development		HHs	70	80	300	225	0	0			370	305	82.4
3	Farm land forage production		Ha	92	60	45	0	0	0			137	60	43.8
4	Oversowing closed areas		Ha	60	24	60	60	0	0			120	84	70.0
5	Foarage production on soil bunds		Km	140	300	108	77	0	0			248	377	152.0

Annex Table 7- Performance of the extension component through Natural Resource Development Activities

Accomplishment of activities targeted in 2007

No	Activities	Unit	Pilot Woreda												
			East Belessa		Lay Gayint		Sekota		Guba Lafto		Tehuledere		Total		
			P	A	P	A	P	A	P	A	P	A	P	A	
1	**Pysical conservation measures**														
1.1	Hill side terrace construction	Km	10.5		50		0	0	0	0	5				
1.2	Farm land terrace construction	ha	0		75		0	0	0	0	20				
	Terrace maintenance	Km	0		0		0	0	0	0	5				
1.3	Checkdam construction	M^3	300		4060		0	0	0	0	100				
1.4	Deep water percolation canal	Km	0		0		0	0	0	0	1				
1.6	Construction of infiltration trench	M^3	710		0		0	0	0	0	0				
1.7	Trench construction on closure area	No	10000		2250		0	0	0	0	8000				
1.8	Small Scale Dam construction	M^3	0		0		0	0	0	0	0				
1.9	Water way construction	M^3	0		2430		0	0	0	0	0				
1.1	Spillway for SS dam	M^3	0		0		0	0	0	0	0				
1.11	Micro basin	No	0		0		0	0	0	0	6000				
1.11	Eye burrow basin	No	0		0		0	0	0	0	4000				
	Recharging pits	No	2		0		0	0	0	0					
1.11	Improved pits	No	0		0		0	0	0	0	5000				
1.12	Cut-off drains	M^3	0		450		0	0	0	0	0				
	Surface water harvesting structure const.	No	1		0		0	0	0	0	0				
1.13	Pond construction	No	0		1		0	0	0	0	0				
1.14	Dom shape water harvesting tank	No	1		0		0	0	0	0	0				
1.15	Trapizoidal shape water harvesting tank	No	1		0		0	0	0	0	0				
	Spring development		0		1		0	0	0	0	0				
1.16	Gabion production	No	380		0		0	0	0	0	0				
2	**Biological masures**		0		0		0	0	0	0	0				
2.1	Compost preparation	M^3	400		0		0	0	0	0	20				
2.2	Pitting and planting ‘000’	No	80		100		0	0	0	0	20				
2.3	Area closure	ha	0				0	0	0	0	0				
3	**Provisions**		0				0	0	0	0	0				
3.1	Polyethlene tube	Q	1		1		0	0	0	0					
3.2	Tree seedling of MPT	Kg	45		50		0	0	0	0					
3.3	Forage seed	Kg	300		250		0	0	0	0	0				
	Drip irrigation equipment	No	6					0	0	0	0				

Annex Table 8 - Performance of the extension component through training,

Accomplishments on trainings targeted in 2007

No	Type of the training	Source of trainees	Pilot Woreda											
			East Belessa		Lay Gayint		Sekota		Guba Lafto		Tehuledere		Total	
			P	A	P	A	P	A	P	A	P	A	P	A
I	Crop production													
	Scaling up of crop technologies	SMS					0	2					0	2
		DAs					0	6					0	6
		Farmers					0	105					0	105
1.1	Fruit crop production	Farmers	45	45	45	0			45	45	45	18	180	108
1.2	IPM/FFS	DAs	0	0							0	3	0	3
		Farmers	72	72							72	33	144	105
II	Livestock												0	0
2.2	Bee Keeping/General apiary/	SMS			0	1					0	4	0	5
		DAs			0	3					0	5	0	8
		Farmers	30	30	30	29	60	77	60	57	60	104	240	297
2.3	Small ruminant management	Farmers	20	0	60		50	0	90	43	65	0	285	43
2.4	Community animal health workers	Farmers					6	0					6	0
III	Natural resource development												0	0
3.5	Land use and administration policy	Committee	30	0	30	26					38	21	98	47
	Total of the project	***SMS***	***0***	***0***	***0***	***1***	***0***	***2***	***0***	***0***	***0***	***4***	0	7
		DAs	***0***	***0***	***0***	***3***	***0***	***6***	***0***	***0***	***0***	***8***	0	17
		Farmers	***197***	***147***	***165***	***55***	***116***	***77***	***195***	***145***	***280***	***176***	953	600

Acronyms

AARC	Adet Agricultural Research Center
ACDI/VOCA	Agricultural Cooperative Development International/Volunteers in Overseas Cooperative Assistance
ACSI	Amhara Credit and Saving Institution
AMSEIDB	Amhara Micro and Small Industries Development Bureau
AMAREW	Amhara Micro-enterprise development, Agricultural Research, Extension and Watershed management
ANRS	Amahra National Regional State
ARARI	Amhara Regional Agricultural Research Institute
ARWS	Animal Range and Wildlife Sciences
ATVET	Agricultural Technical Vocational Education Training
AU	Alemaya University
BDU	Bahir Dar University
BoARD	Bureau of Agriculture and Rural Development
BoFED	Bureau of Finance and Economic Development
CAHW	Community Animal Health Workers
CARMPoLEA	Center for Agricultural Research Management Policy Learning in Eastern and Southern Africa
CIP	Centro International de la Papa
COLTA	Community Organization Leadership Training for Action
Chief of Party	Chief of Party
CPB	Cooperatives Promotion Bureau
CRSP	Collaborative Research Support Program
CTO	Cognizant Technical Officer
CV	Curriculum Vitae
CWMO	Community Watershed Management Organization
DA	Development Agent
DBARC	Debre Berhan Agricultural Research Center
DCHS	Dryland Crop and Horticultural Sciences
DG	Director General
DLS	Diffused Light Storage

DU	Debub University
EARO	Ethiopian Agricultural Research Organization
EIAR	Ethiopian Institute of Agricultural Research
EPLAUA	Environmental Protection, Land Administration and Use Authority
EWMA	Extension Watershed Management Advisor
FA	Farmer Administration
FDANR-DCE	Faculty of Dryland Agriculture and Natural Resources – Distance and Continuing Education
FFS	Farmers' Field School
FREG	Farmer-Research-Extension Group
FSPCDPO	Food Security Program Coordination & Disaster Prevention Office
FTC	Farmer Training Center
FtF	Farmer to Farmer
GARC	Gondar Agricultural Research Center
GIS	Geographical Information System
HH	House Hold
HU	Haramaya University
ICM	Integrated Crop Management
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
ISNAR	International Support for National Agricultural Research
INTSORMIL	International Sorghum and Millet
IPM	Integrated Pest Management
IR	Intermediate Result
ISP	Integrated Strategic Plan
IWDMT	Integrated Watershed Development and Management Team
KSA	Knowledge, Skill, and Attitude
LaRMEP	Land Resource Management and Environmental Protection
MARC	Melkasa Agricultural Research Center
MED	Micro Enterprise Development
M&E	Monitoring and Evaluation
MoARD	Ministry of Agriculture and Rural Development
MoFED	Ministry of Finance and Economic Development
MoU	Memorandum of Understanding

Mt	Metric ton
MU	Mekelle University
N	Nitrogen
NGO	Non Governmental Organization
NREM	Natural Resource Economics and Management
NRM	Natural Resource Management
OIRED	Office of International Research, Education, and Development
ORDA	Organization for Rehabilitation and Development in Amahra
Program Administrator	Peasant Association
REFAC	Research Extension Farmer Advisory Council
RA	Research Advisor
RC	Research Center
R-E	Research Extension
RIT	Regional Implementation Team
SARC	Sirinka Agricultural Research Center
SDARC	Sekota Dryland Agricultural Research Center
SGMP	Small Grants and Mentorship Program
SIDA	Swidish International Development Agency
SMS	Subject Matter Specialist
SO	Strategic Objective
SoW	Scope of Work
SWHISA	Sustainable Water Harvesting and Institutional Support Assistance
TAC	Technical Advisory Council
USAID	United States Agency for International Development
VSU	Virginia State University
VT	Virginia Tech
WA	Watershed Association
WOARD	Woreda Office of Agriculture and Rural Development