1.   General Information

Project title: Unlocking the potential of rainfed agriculture in Ethiopia for improved rural livelihoods

Duration of the project: Three years

Applicant: International Center for Agricultural Research in the Dry Areas (ICARDA)

Partners: Department of Water, Atmosphere and Environment, Institute of Hydraulics and Rural Water Management, University of Natural Resources and Applied Life Sciences (BOKU), Vienna

Ethiopia Institute of Agriculture Research (EIAR), Ministry of Agriculture and Rural Development, Addis Ababa, Ethiopia

Amhara Regional Agricultural Research Institute (ARARI), Ethiopia

Ethiopia Sasakawa Global 2000, Ethiopia

Budget: Total: € 699,580. Requested from Austria: € 498,580

Other financing: € 201,000

2.   Executive Summary

The proposed project builds upon on-going applied research in the dry lands of Ethiopia conducted by the national agricultural research systems, ICARDA and other international organizations. Ethiopia has great agricultural potential because of its vast areas of fertile land, diverse climate, generally abundant rainfall, and large labor force. Despite this great potential, Ethiopian agriculture has remained underdeveloped and poverty prevails especially in rural areas. Several technical, economical, financial and political reasons are responsible. Drought, has persistently affected the country since the early 1970s together with poor economic base (low productivity, weak infrastructure, and low level of technology). Consequently, the country faced a tragic famine that resulted in the death of nearly 1 million people from l984 to 1986. People in the rural areas of Amhara region are very poor and this is partly due to low agricultural productivity.

One of the most important agro-ecosystems in Ethiopia, the rainfed agricultural system, is functioning way below its potential. Particularly in the Amhara region, crop yields are very low despite the usually high total seasonal rainfall (400- >1000 mm annual). Reasons for low productivity include moisture stress, low fertility and low yielding crop varieties. Although total rainfall may be adequate for crops growth the distribution is usually uneven over the cropping season leaving dry spells during which the crop is exposed to sever moisture stress that is substantially effecting its growth and yield. Furthermore, the soils in many areas are shallow and//or sandy with low water holding capacity. Even though the rainfall amounts are sometimes adequate, the soil profile cannot hold it where most of it either deep percolated or lost down to ground water or runoff downstream. Crops then suffer severe moisture stress. In addition soils in Amhara rainfed areas are generally poor in nutrients. Small farmers are either unable to provide fertilizers or do not know the appropriate applications. Much of added fertilizers are leached out with water below root zone. Finally, improved crop varieties are not readily available to farmers and the ones available do not meet the farming conditions. For that and other local reasons the rainfed agriculture in

Ethiopia in general and in Amhara region in particular has low productivity and urgently need to be improved to contribute to alleviating poverty in the area.

The proposed project aims at improving the livelihoods of the rural communities in the rainfed agro-ecosystem of the Amhara region of Ethiopia. This will be reached by sustainably improve agricultural productivity and conserve the ecosystem resources by the integration of affordable and appropriate technologies in a favorable socioeconomic environment. The project will select, model and analyze a typical rainfed system at the watershed level to identify and quantify the constraints contributing to low productivity. Furthermore, the project will identify, evaluate and apply appropriate interventions that may overcome the deficiencies and achieve higher productivity. As moisture stress during crop growing season is known to be a major constraint to system productivity, the project will test and fine tune a package of water harvesting technologies that provides sufficient water for targeted supplemental irrigation during dry spells to alleviate stress. Improving soil water will allow more inputs to be introduced including fertility and improved varieties of major cereals and legume crops. The project will further evaluate the interventions and study the interventions potential consequences particularly on the people livelihoods, the ecosystem and on the downstream users. The project outputs will be out scaled to relevant areas by developing appropriate policies and agro ecological characterization of the area.

The project will be implemented in Amhara region, is community-based and will follow problem-solving participatory approaches. It will work within an integrated watershed development framework and will address the biophysical, socio-economic, policy and institutional problems in an integrated approach. The project will enhance the capacity of all stakeholders including community leaders, extension agents and research personnel of NARES. The project focuses on short-term benefits for households, medium-term benefits for communities and long-term benefits for the society. Expected project outputs include:

(1) Watershed and communities representing rainfed agro-ecosystem in Amhara region selected, characterized, and mobilized for implementing integrated research.

(2) Appropriate system model at the watershed level, selected, verified and used to describe the system elements, productivity and constraints to improved performance

(3) Integrated water harvesting/supplemental irrigation system that is suitable and affordable to farmers developed, tested, fine tuned and applied by local communities in the target area.

(4) Improved agronomic practices including fertility and improved crop varieties and diversification options developed and tested together with the water improvement measures.

(5) Methodology and application for assessing water productivity before and after the project implementation and the consequences of improved system performance on people and downstream users.

(6) Dissemination and out scaling plan including improved policies.

(7) Trained nationals able to pursue the dissemination of outputs and develop new options for improved rainfed systems in the region and the country

The three-year project will identify and select typical rainfed watershed and communities, form watershed associations, carry out resource assessments and livelihood analyses, and develop community action plans during the first year. Selection of research sites and participating farmers in targeted agro ecosystems will also be completed in the first year. A suitable system model will be identified in the first year and verified for the conditions at the selected watershed. The project will identify and introduce supplemental irrigation, water harvesting and agronomic interventions, as agreed with the participating communities, at the end of the first year. Testing and monitoring of the interventions will continue to the third

year. Results will be presented in annual planning meetings each year. Institutional and policy recommendations will be developed during the third year.

ICARDA will be responsible for overall coordination and management of the project, including technical and financial reporting. The national institutes, EIAR and ARARI, will be responsible for the field activities with the technical assistance of ICARDA. BOKU will provide specialist assistance in the modeling, the resource assessments and training. A technical advisory committee will be responsible for project implementation and will oversee the development of annual work plans, budgets and their execution. The project is designed to foster bottom-up decision-making and the watershed associations formed by the project will be the main research partners at the local level.

The research results will be used by rainfed areas extension services dealing with rural communities in enhancing their small scale poor-resources farmers' agricultural productivity and conserving the fragile ecologies. As a result water harvesting and supplemental irrigation in addition to improved agronomic inputs should contribute to higher system productivity and reduced degradation of the sloping lands and terraced fields. Efficient use of harvested water will improve the chance of small farm productivity and sustainability. The adoption of technical, institutional and policy recommendations will provide the basis for regulation of water resources for optimum and sustainable development. The approaches and methodologies developed by the project will be transferable to similar environments. The main users of the research include the participating farm communities, extension workers, graduating students, policy makers and national and international researchers.

At the household level, expected impacts will be increased crop and livestock production and reduced sloping and terrace field damage, resulting in improved livelihoods. Communities will benefit from empowerment in decision-making and enhanced capacity in common pool resource management. The project will enhance the capacity of institutions in management and rehabilitation of rainfed systems natural resources vis-à-vis livelihood improvement strategies.

3.   Project staff and cooperating partners

3.1   Composition of ICARDA research team and team leaders

The CVs of principal team members are attached in Annex 2. The ICARDA team consists of:
- Dr. Stefania Grando, Barley Breeder
- Dr. Simeon Kaitibie, Applied Agricultural Economist
- Dr. Seid Kamel, Legume Pathologist
- Dr. Fawzi Karajeh, Regional Coordinator, Nile Valley and Sub-Saharan Africa Program
- Dr. Theib Oweis, Director, Integrated Water and Land Management Program
- Dr. Rolf Sommer, Soil fertility specialist (Team Leader)
- Dr. Feras Ziadat, Soil Conservation and Land Management Specialist

3.2   Collaborating institutions and staff

The **Ethiopian Institute of Agriculture Research** (EIAR) is the federal institute responsible for agricultural research in Ethiopia. It provides support to all regional research institutes and has a broad mandate on natural resources management, crop improvement and socioeconomic aspects. The institute had supervised and conducted research in all areas of Ethiopia. The institute works closely with the ARARI in Amhara on issues associated with water and land management issues and crop breeding programs in addition to policies and institutional aspects. Senior scientists from the institute that will participate in this research include: Dr. Getachew Belay, Dr. Bedada Girma and Dr. Kemal Ali Ahmed.

Amhara Regional Agricultural Research Institute (ARARI) is the principal agricultural research institute in Amhara region and oversees all other institutes at the district level. The institute has the autonomy to conduct research in the Amhara region and to engage in agreements for cooperation with research organizations in Ethiopia and outside the country. ARARI has staff of multi-disciplinary nature and cover all aspects of agriculture. It supervises research stations in major agricultural areas of Amhara and engages in research projects with international organizations including ICARDA. Scientist from the institute that will participate in this project include: Dr. Fentahun Mengistu (Director General of ARARI), Dr. Birru Yitaferu (Director of Soil and Water Research Group), Dr. Gizaw Desta, M.Sc. Tatek Dejen.

Ethiopia Sasakawa Global 2000 (SG 2000) is a collaborative program established between the Sasakawa Africa Association (SAA) and the Global 2000 program of the Carter Center to find ways to raise the productivity of African farmers. SG 2000's mission is to assist sub-Saharan African governments reduce poverty, enhance food security, and protect the natural resource base through the accelerated adoption of productivity-enhancing agricultural technologies. From 1986 up to 2003, SAA operated in ten countries (Ghana, Nigeria, Burkina Faso, Mali, Guinea, Ethiopia, Tanzania, Uganda, Malawi and Mozambique). Then the SAA Board of Directors decided in 2004 to concentrate on a smaller number of countries. It chose Ethiopia, Mali, Nigeria and Uganda to receive 75% of the staff's attention and the Program's resources. Linkage to this project will be ensured through Dr. Aberra Debelo, Director.

BOKU - University of Natural Resources and Applied Life Sciences, Vienna is a leading institute on research and training in rural water management and surface runoff and soil erosion modeling. Watershed-scale assessment of water and soil loss is required to know the potential impacts of upstream development at downstream and the scale of development. The institute will work on this important aspect vis-à-vis giving training to the graduate student or staff from NARS. Prof. DI Dr. Andreas Klik will be responsible for research on soil erosion and its consequences and Prof. DI Dr. Hans-Peter Nachtnebel will collaborate on research in water resource assessment and management.

4. Project background and justification

4.1 The Problem and Project Justification

The proposed project builds upon on-going applied research in the dry lands of Ethiopia conducted by the national agricultural research systems, ICARDA and other international organizations. Ethiopia has great agricultural potential because of its vast areas of fertile land, diverse climate, generally abundant rainfall, and large labor force. Despite this great potential, Ethiopian agriculture has remained underdeveloped and poverty prevails especially in rural areas. Several technical, economical, financial and political reasons are responsible. Drought, has persistently affected the country since the early 1970s together with poor economic base (low productivity, weak infrastructure, and low level of technology). Consequently, the country faced a tragic famine that resulted in the death of nearly 1 million people from l984 to 1986. People in the rural areas of Amhara region are very poor and this is partly due to low agricultural productivity.
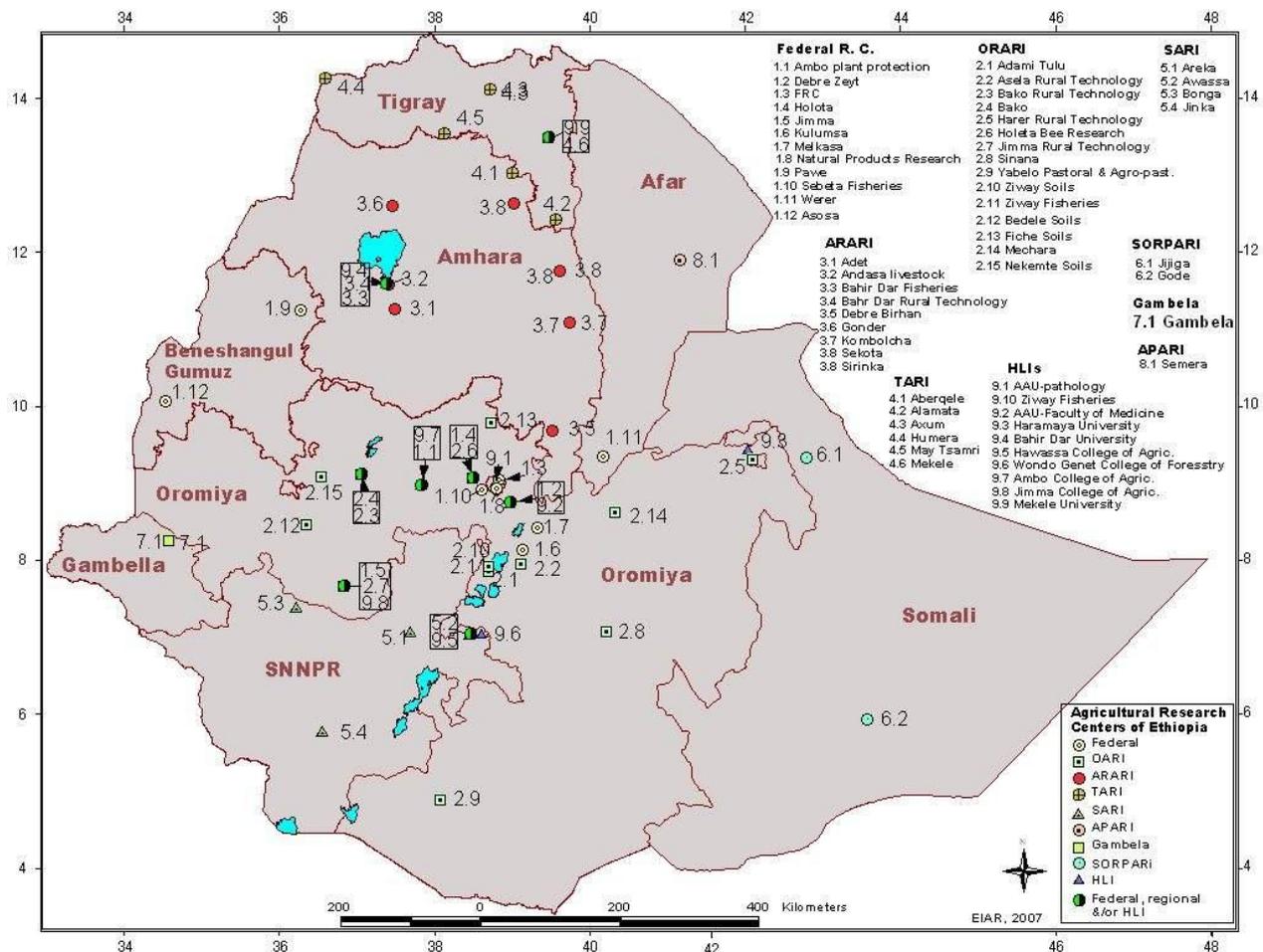
One of the most important agro-ecosystems in Ethiopia, the rainfed agricultural system, is functioning way below its potential. Particularly in the Amhara region, crop yields are very low despite the usually high total seasonal rainfall (400 to >1000 mm annual). Reasons for low productivity include moisture stress, low fertility and low yielding crop varieties. Although total rainfall may be adequate for crops growth the distribution is usually uneven over the cropping season leaving dry spells during which the crop is exposed to sever moisture stress that is substantially effecting its growth and yield. Furthermore, the soils in many areas are shallow and//or sandy with low water holding capacity. Even though the rainfall

amounts are sometimes adequate, the soil profile cannot hold it where most of it either deep percolated or lost down to ground water or runoff downstream. Crops then suffer severe moisture stress. In addition soils in Amhara rainfed areas are generally poor in nutrients. Small farmers are either unable to provide fertilizers or do not know the appropriate applications. Much of added fertilizers are leached out with water below root zone. Finally, improved crop varieties are not readily available to farmers and the ones available do not meet the farming conditions. For that and other local reasons the rainfed agriculture in Ethiopia in general and in Amhara region in particular has low productivity and urgently need to be improved to contribute to alleviating poverty in the area.

4.2   **The Project**

The proposed project aims at improving the livelihoods of the rural communities in the rainfed agro-ecosystem of the Amhara region of Ethiopia. This will be reached by sustainably improve agricultural productivity and conserve the ecosystem resources by the integration of affordable and appropriate technologies in a favorable socioeconomic environment. The project will select, model and analyze a typical rainfed system at the watershed level to identify and quantify the constraints contributing to low productivity. Furthermore, the project will identify, evaluate and apply appropriate interventions that may overcome the deficiencies and achieve higher productivity. As moisture stress during crop growing season is known to be a major constraint to system productivity, the project will test and fine tune a package of water harvesting technologies that provides sufficient water for targeted supplemental irrigation during dry spells to alleviate stress. Improving soil water will allow more inputs to be introduced including fertility and improved varieties of major cereals and legume crops. The project will further evaluate the interventions and study the interventions potential consequences particularly on the people livelihoods, the ecosystem and on the downstream users. The project outputs will be out scaled to relevant areas by developing appropriate policies and agro ecological characterization of the area.

The project will be implemented in Amhara region (see map below). It is community-based and will follow problem-solving participatory approaches. It will work within an integrated watershed development framework and will address the biophysical, socio-economic, policy and institutional problems in an integrated approach. The project will enhance the capacity of all stakeholders including community leaders, extension agents and research personnel of NARES.

Agricultural Research Centers of Ethiopia map (EIAR, 2007)

Federal R. C.
1.1 Ambo plant protection
1.2 Debre Zeyt
1.3 FRC
1.4 Holota
1.5 Jimma
1.6 Kulumsa
1.7 Melkasa
1.8 Natural Products Research
1.9 Pawe
1.10 Sebeta Fisheries
1.11 Werer
1.12 Asosa

ARARI
3.1 Adet
3.2 Andasa livestock
3.3 Bahir Dar Fisheries
3.4 Bahir Dar Rural Technology
3.5 Debre Birhan
3.6 Gonder
3.7 Kombolcha
3.8 Sekota
3.8 Sirinka

TARI
4.1 Aberqele
4.2 Alamata
4.3 Axum
4.4 Humera
4.5 May Tsamri
4.6 Mekele

ORARI
2.1 Adami Tulu
2.2 Asela Rural Technology
2.3 Bako Rural Technology
2.4 Bako
2.5 Harer Rural Technology
2.6 Holeta Bee Research
2.7 Jimma Rural Technology
2.8 Sinana
2.9 Yabelo Pastoral & Agro-past.
2.10 Ziway Soils
2.11 Ziway Fisheries
2.12 Bedele Soils
2.13 Fiche Soils
2.14 Mechara
2.15 Nekemte Soils

HLIs
9.1 AAU-pathology
9.10 Ziway Fisheries
9.2 AAU-Faculty of Medicine
9.3 Haramaya University
9.4 Bahir Dar University
9.5 Hawassa College of Agric.
9.6 Wondo Genet College of Foresstry
9.7 Ambo College of Agric.
9.8 Jimma College of Agric.
9.9 Mekele University

SARI
5.1 Areka
5.2 Awassa
5.3 Bonga
5.4 Jinka

SORPARI
6.1 Jijiga
6.2 Gode

Gambela
7.1 Gambela

APARI
8.1 Semera

Agricultural Research Centers of Ethiopia (legend)
- Federal
- OARI
- ARARI
- TARI
- SARI
- APARI
- Gambela
- SORPARi
- HLI
- Federal, regional &/or HLI

4.3 Coherence of the Project with CGIAR Priorities

The project focuses on sustainable natural resource management to improve livelihoods and achieve food security through enhanced agricultural productivity. The project is consistent with the CGIAR System Priorities, specifically System Priority 4 on *Poverty alleviation and sustainable management of water, land and forest resources*: Priority 4A on *Integrated land, water and forest management at landscape level*, Priority 4C on *Improving water productivity* and Priority 4D on *Sustainable agro-ecological intensification in low- and high-potential environments* .

4.4 Coherence of the Project with Austrian Funding Priorities

The project will address the ADA Thematic Priority 2.1 (Sustainable increase in food production and agricultural productivity) through the enhancement of on-farm water productivity; Thematic Priority 2.2 (Conservation of biodiversity and sustainable natural resource management) through measures to improve vegetation on wastelands; Thematic Priority 2.3 (Development of sustainable production and marketing system) and Thematic Priority 2.4 (Strengthening institutions and fostering policy development) by empowering communities through the establishment of watershed associations, capacity building, and integration of the research, development and extension services in the project area. The project responds to the great needs of Ethiopia for alleviating poverty, a top priority country for the ADA.

4.5   Research Methodology

The three year project will identify and select typical rainfed watershed and communities, form watershed associations, carry out resource assessments and livelihood analyses, and develop community action plans during the first year. Selection of research sites and participating farmers in targeted agro ecosystems will also be completed in the first year. A suitable system model will be identified in the first year and verified for the conditions at the selected watershed. The project will identify and introduce supplemental irrigation, water harvesting and agronomic interventions, as agreed with the participating communities, at the end of the first year. Testing and monitoring of the interventions will continue to the third year. Results will be presented in annual planning meetings each year. Institutional and policy recommendations will be developed during the third year.

4.6   Expected users and uses of research results

The research results will be used by rainfed areas extension services dealing with rural communities in enhancing their small scale poor-resources farmers' agricultural productivity and conserving the fragile ecologies. As a result water harvesting and supplemental irrigation in addition to improved agronomic inputs should contribute to higher system productivity and reduced degradation of the sloping lands and terraced fields. Efficient use of harvested water will improve the chance of small farm productivity and sustainability. The adoption of technical, institutional and policy recommendations will provide the basis for regulation of water resources for optimum and sustainable development. The approaches and methodologies developed by the project will be transferable to similar environments. The main users of the research include the participating farm communities, extension workers, graduating students, policy makers and national and international researchers.

At the household level, expected impacts will be increased crop and livestock production and reduced sloping and terrace field damage, resulting in improved livelihoods. Communities will benefit from empowerment in decision-making and enhanced capacity in common pool resource management. The project will enhance the capacity of institutions in management and rehabilitation of rainfed systems natural resources vis-à-vis livelihood improvement strategies.

4.7   Budge Summary (Euro)

Institution	Year 1	Year 2	Year 3	Total
Contribution from Austria:				
ICARDA	80,320	86,410	83,970	250,700
BOKU	13,800	17,250	15,530	46,580
NARS partners	48,400	75,900	77,000	201,300
Total requested	**142,520**	**179,560**	**176,500**	**498,580**
Co-financing	67,000	67,000	67,000	201,000
Total Cost	**209,520**	**246,560**	**243,500**	**699,580**

5. Project Description and Work Plan

5.1 Project Description

5.1.1 Project Goal

Improved livelihoods and food security of the rural people in the rainfed areas of Ethiopia through sustainable management of rainwater, land rand human resources, and increased water productivity and income of poor farming communities.

5.1.2 Purpose

The project purpose is to develop, demonstrate, and evaluate innovative and cost-effective technologies and methodologies based on water harvesting and supplemental irrigation for efficient use and monitoring of available water and land resources for crop and livestock improvement and sustainable land management.

5.1.3 Outputs

1. Watershed and communities representing rainfed agro-ecosystem in Amhara region selected, characterized, and mobilized for implementing integrated research. The selected watershed will be used as a benchmark for developing and disseminating improved options for rainfed agriculture.
2. Appropriate system model at the watershed level, selected, verified and used to describe and analyze the system dynamics, productivity and the constraints to improved performance.
3. Integrated water harvesting/supplemental irrigation systems suitable and affordable to poor farmers developed, tested, fine tuned and applied together with suitable agronomic practices including fertility recommendations, improved crop varieties and diversification options.
4. Assessment of potential water and land productivity and sustainability at the watershed level with analysis of the consequences of improved system performance on the people and on downstream users.
5. Trained nationals able to pursue the dissemination of outputs and develop new options for improved rainfed systems in the region and the country
6. Technical and policy recommendations for best watershed management practices, research publications and graduate research thesis.

5.1.4 Activities and indicators

The specific activities, according to output, are as follows:

Output 1

Watershed and communities representing rainfed agro-ecosystem in Amhara region selected, characterized, and mobilized for implementing integrated research. The selected watershed will be used as a benchmark for developing and disseminating improved options for rainfed agriculture.

Indicators: Watershed and communities characterized, watershed association established, assessment report and community action plan documented and agreed with the community.

Rationale: In integrated watershed development, assessment of land and water resources is a basic input for their optimal uses and sustainable management. Similarly, in-depth understanding of the current socioeconomic situation of rural people is essential for gauging

ex ante the feasibility of technological options as well as establishing the basis for assessing the effects of interventions introduced by the project.

Activity 1.1: Organizing communities and consulting stakeholders in the area. Meetings for stakeholders and Technical Committee to develop the first annual work plan, and a team and criteria for watershed selection, rapid rural appraisal and watershed selection

A Stakeholders' meeting will be organized to develop the first annual work plan and to build a resource team for watershed selection. Criteria for watershed selection will be identified, and potential watersheds suggested. The meeting will also constitute a technical committee (TC) to oversee the execution of the annual work plan. The technical committee would meet twice a year, and will comprise representatives from all partners in addition to representatives of local government. The resource team will identify all potential watersheds, carry out a rapid rural appraisal (RRA) in these watersheds, and evaluate and prioritize the watersheds. A stakeholder meeting will be organized discuss the findings of the watershed selection team and to decide on the watershed to work with.

Activity 1.2: Collect baseline information and analyze livelihood and natural resources at watershed-scale

The project will hold introductory meetings in the watershed to explain the objectives of the project, the roles of the different stakeholders, and guidelines for the formation and functions of a watershed association. The project will further assist the watershed communities with the development of the watershed association and the election of its leaders. A socioeconomic survey will be conducted to collect data on demographics, land ownership, land use, livestock assets, crop production, cropping patterns and yield, sources of income, and market and livelihood opportunities, and identify the main production and resource management constraints. A wide range of economic and non-economic indicators of rural livelihoods will be applied to assess rural poverty and identify those most vulnerable. The activity will also focus to performance assessment of conventional farming and natural resource management practices and analyze the asset endowments and livelihood strategies of rural people in order to better target technological, policy and institutional options to the needs of poor.

Existing data (climate, rainfall, runoff, sediment, topography, maps, soil and land use) will be collected and analyzed. Participatory field surveys and transects walks will be conducted to characterize the physical conditions of the watershed, including water, soil, crops, and plant species, using a wide range of indicators. An assessment of the water resources under average and extreme conditions will be made. Potential land use scenarios will be developed with the watershed communities members. Current and potential water and land use scenarios will be analyzed using a runoff assessment approach. The assessment will form a basis for management planning.

Activity 1.3: Development of watershed principles, and preparation of community action plan for the watershed management

The findings of the livelihood and natural resource assessments will be presented and discussed with the watershed association members. Participatory tools will be used to assist with the integration of these findings and the development of guidelines for watershed management with the watershed association. Focused group meetings and formal and informal discussions will formulate strategies for sustainable enhancement of production capacities of arable and non-arable lands, halting the environmental degradation, and the relations and effects between the management and use of up- and downstream lands. The agreed watershed principles and community actions will be documented within a community watershed action plan.

Output 2

Appropriate system model at the watershed level, selected, verified and used to describe and analyze the system dynamics, productivity and the constraints to improved performance.

<u>Indicators</u>*:* Rainfed system at the watershed level described, analyzed and constraints identified. People at the NARES able to use the model and conduct independent analysis.

<u>Rationale</u>*:* Due to the variability in topography, soils rainfall and practices at the watershed level a model that can describe the system is needed. Practices at the farm level are usually site specific. It is important that these are modeled to be able to generalize across ha watershed and beyond.

<u>Activity 2.1:</u> *Selection of suitable system model at the watershed level*

Expert meeting will be conducted including NARES and partners institutes to discuss the suitability of various available models. Criteria for the selection will be developed, applied to promising models and finally a model will be selected.

<u>Activity 2.2:</u> *Data collection, calibration and verification of the model*

Data required by the model will be collected from secondary sources and from the field for the unavailable data. Data is likely to include historic climatic data, soil and water data and crop yields under various conditions especially various rainfall amounts. The model will be calibrated to the selected watershed conditions and verified with available output data.

<u>Activity 2.3:</u> *Model application for rainfed system analysis*

The model once proved suitable and describes reasonably the system parameters will be used to analyze the dynamics of the rainfed system. Important to run scenarios and identify the major constraints to improved system productivity. The contribution of various constraints to the yield and sustainability parameters will be quantified for action.

Output 3

Integrated water harvesting/supplemental irrigation systems suitable and affordable to poor farmers developed, tested, fine tuned and applied together with suitable agronomic practices including fertility recommendations and improved crop varieties and diversification options by local communities in the target area.

<u>Indicator</u>: Productivity of the rainfed system that is applying the technologies increased by at least 100% and soil erosion reduced by 50%. Increased awareness of the system requirements and productivity soil and water.

<u>Rationale</u>*:* The rainfed system has very low productivity and is subject to degradation. Rainwater is mainly lost in deep percolation and runoff. Other agronomic inputs are lacking. As a result poverty is widespread in this rural area. Water harvesting is a viable way to capture rainfall runoff. Supplemental irrigation can alleviate stress and overcome low yields.

<u>Activity 3.1:</u> *Participatory selection of a representative farms, and design of suitable water harvesting and supplemental irrigation systems*

Representative farms across the watershed will be selected characterized and designed for interventions together with the farmers and the community leaders. Participatory development of the interventions will be conducted. The interventions will be designed based on local conditions and farmers acceptance.

<u>Activity 3.2:</u> *Implementation of water harvesting and supplemental irrigation systems at the farm and community levels*

This activity will include implementing recommended interventions of water harvesting and supplemental irrigation together with agronomic practices at the farm and community levels.

It is likely that low cost small farm reservoirs will be designed and built and suitable supplemental irrigation systems implemented together with levels of inputs to be tested at the farms.

Activity 3.3: Monitoring and analysis of the system performance

This activity will run for two seasons and results will be analyzed and recommendations developed. The productivity of the crops and the rainwater will be assed as a result of the interventions. Runoff water and soil erosion will also be monitored and assessed. NARES and farmers will be fully involved in this activity as they will implement and evaluate.

Simple monitoring tools will be developed for use by the community watershed association and extension services. Local soil and water quality indicators will be developed with the community, working together with extension and research agencies to develop a common understanding of quality issues and the establishment of local monitoring units. More scientific data will be required for an in-depth understanding of the prevailing processes in order to develop guidelines for the rainfed system improvement. This will involve measurement of changes in water, soil loss and vegetation cover in relation to the baseline, and will require installation of monitoring equipment such as meteorological station, rain gauges, runoff recorder, soil loss pits or check structures. The data will be analyzed and evaluated using the model selected to be used in the project.

Output 4

Assessment of potential water and land productivity and sustainability at the watershed level with analysis of the consequences of improved system performance on the people and on downstream users.

Indicators: A document describing the methodology developed and the results of the analysis published.

Rationale: Introducing water harvesting systems in the rainfed areas and using supplemental irrigation will modify the dynamics of the area. Water and land productivity will certainly increase. Less water will runoff downstream and more water will be used in evapotranspiration of the crops. More fertilizers are expected to be used. All those changes will affect the ecosystem and the downstream flows and uses. It is important that such consequences be analyzed and become clear to policy makers and watershed associations.

Activity 4.1: Zoning of the watershed

Agro-eco-zoning of the watershed will be conducted to identify major zones representing various conditions. This will be a GIS based and will involve parameters such as rainfall and other climatic factors, soils, topography, cropping systems and socioeconomic conditions.

Activity 4.2: Determination of potential supplemental irrigation and water harvesting

A methodology developed by ICARDA (De Pauw et al 2007) will be applied to determine potential areas suitable for implementing water harvesting and supplemental irrigation in the watershed. Changed of water balance parameters will follow.

Activity 4.3: Determination of water and land productivity at the watershed level

Historic yields and those produced by the project together with water consumption will be used to determine existing water and land productivity and its potential when the project outputs are implemented at the watershed.

Output 5

Trained nationals able to pursue the dissemination of outputs and develop new options for improved rainfed systems in the region and the country

Indicators: Trained staff, better equipped extension services, well acquainted decision-makers and graduate students

Rationale: The communities and national institutions are the custodians of the improved systems and primarily responsible for disseminating the proven technologies and methodologies. Therefore, building their capacity is a major function of the project.

Activity 5.1: On-the-job training

Participating staff from the collaborating research institutions and community and watershed association leaders will receive training in resource assessment and management through "learning by doing" in participatory approaches.

Activity 5.2: Formal training

Short-term formal training will include local training for the watershed association members in farm management practices, water management and crop related activities. Farmers' field days and traveling workshops will be organized. Field demonstrations, brochures and other media will be used as training material. Short-term training for the national research institutes will include study tours, workshops and special training courses provided by ICARDA and BOKU. The project will also support graduate students registered with the national universities, who will conduct their research within the project under the joint supervision of ICARDA and/or BOKU. They will also participate in short-term training and visits to ICARDA or BOKU.

Output 6

Technical and policy recommendations for best watershed management practices, research publications and graduate research thesis.

Indicators: Recommended water harvesting and supplemental irrigation practices for sustainable rainfed systems management are available to the communities and national research and development institutions for use and out-scaling. Publications (articles, policy brief and brochures) are used elsewhere as a reference for integrated watershed management.

Rationale: The knowledge generated and experience gained through the project will have wider applications if well documented and disseminated as a public good.

Activity 6.1: Comprehensive technical and policy recommendations

Results from the three year project activities will be compiled and synthesized and guidelines developed. The project will hold a workshop of all the stakeholders and policy makers, at which the results will be presented and policy briefs will be developed. These brief will be largely circulated among the scientists, policy makers and users for their comments and will be finalized in the form of technical and policy recommendations and watershed best management practices.

Activity 6.2: Dissemination and promotion of the research results for greater impact

The research results will be disseminated through i) field days and traveling workshops and ii) brochures, policy brief and annual and final workshops. The field days and traveling workshops will help the community and farmers and extension services to directly participate and 'learn by seeing'. Simple brochures in local language will disseminate the results to a larger section of the population in the region. Policy brief and arranged visits with the decision-makers will disseminate the results to provincial and national government officers. The coverage of the major project events in the mass media will disseminate the results to vast population in the country.

Activity 6.3: Project final workshop

Final workshop will present overall achievements of the project.

5.1.5 Monitoring and evaluation processes and methodologies

Monitoring and evaluation of the project implementation is built on the experience of ICARDA and NARES partners applied research component, which followed a program of monthly monitoring and yearly evaluation meetings. An annual planning and progress review meeting of all the stakeholders is held each year. ICARDA coordinates and assists the partner institutions to develop annual work plans in line with the project objectives and planned outputs. Each collaborating institution presents its results for the current year and work plan for the next year in the annual meeting. The achievement and constraints to project implementation, if any, are discussed in relation to the work plan. The thematic groups discuss the project plans and progress in accordance with the project objectives and develop guidelines for future directions. During the planning year, ICARDA coordinates to ensure implementation of the planned activities and provides technical assistance. ICARDA's Addis Ababa office maintains close contacts with the national collaborating institutions through monthly progress review meetings. Weather station, rain gauges, runoff recorders and sediment measurement instruments will be installed at appropriate locations to monitor the climatic parameters and water and soil losses. Soil moisture will be measured by gravimetric methods at surface and with Time Domain Reflectometery (TDR) or equivalent arrangement. Improvement of vegetation cover in the range and forest area will be measured twice a year. Improvement in crop yield will be measured by taking representative samples. Necessary structures for water harvesting will be constructed and equipment will be procured.

5.1.6 Dissemination and training

The participatory approach adopted by the project, whereby communities work together with the research team in identifying and testing options, is a main pathway to knowledge dissemination and technology transfer. Field days and traveling workshops (whereby groups on farmers and researchers travel together to observe activities at different sites) will be mechanism of knowledge dissemination to end users. As indicated in the activities, participating farmers will receive hands-on training in water, soil and crop management practices. The national collaborating partners will receive training in participatory approaches, research design, data acquisition and processing, and water resource assessment. Training will be provided by ICARDA, national research centers, Universities and BOKU.

5.2   Work Plan and Timeframe

5.2.1 Main inputs

About 40 person months of ICARDA, 10 person months of BOKU and 120 person months of NARS will be required. Project staffing includes input of 12 person months of scientists' time from ICARDA (coordinator and NFP), 8 person months by BOKU (research associate) and 60 person months of NARS scientists. Remaining will be contribution by ICARDA, BOKU and NARS. The project budget provides for a national professional officer, short-term local consultancies and honoraria for NARS staff working on the project. Operational expenses, materials, and supplies will be provided through the project. The proposed project will support all procurement, including equipment and material for the structures.

5.2.2 Time schedule

The time schedule for research activities, according to the logframe, is shown in Annex 1.

5.3   Project Management

ICARDA will be responsible for overall coordination and management of the project, including technical and financial reporting. ICARDA will assist the national partners in water harvesting and watershed approaches, soil conservation, hydrological assessment, crop management, rangeland rehabilitation and socio-economic assessments. ARARI will be responsible for activities and outputs related to water and soil management, crop production, and EIAR for socioeconomic and policy research. The Department of Water, Atmosphere and Environment, Institute of Hydraulics and Rural Water Management, BOKU will provide specialist assistance in the modeling, resource assessments and training. A Technical Advisory Committee will be responsible for overseeing project implementation in accordance with annual work plans and budgets. The project is designed to foster bottom-up decision-making; the watershed association will be the main research partner at local level.

6.   Expected Impact

The expected impacts at household level are envisaged as increased crop yield and livestock feed, and reduced erosion and field damages. At community level empowerment and enhanced capacity in common pool resource management. At watershed scale conservation of vulnerable ecosystems, improved vegetation cover and better regulation of runoff to improve soil-moisture and reduce its destructive impacts. At institution level the impacts include the enhanced capacity in water and land management and natural resources vis-à-vis livelihood improvement strategies. Availability of guidelines and watershed best management practices at regional and national levels will be the project contribution. Research articles will serve as public goods at international level. The projects other expected benefits include improved water productivity and reduced destructive peak runoff, reduced land degradation and increased opportunities for conservation of bio-diversity through the harmonization of policy and regulations supporting sustainable management of rainfed systems at watershed landscape level, and increased capacity of the stakeholders to implement cross-sectoral approaches to water and land management. Availability of replicable methodologies to improve productivity and conserve natural resources for out-scaling will also be the impacts of the project.

7.   Probability of success

The probability of success is judged from the timely financial availability, experience of the implementing agency and collaborators for similar projects and environment, support from community and national institutions, climatic factors and project design. ADA initiative on this project is less likely to smooth financial flow interruption. ICARDA have been working in similar activities and several success examples are documented. They know the environment and are known by the environment very well. Some of the farm-scale tested technologies are already available for testing their effectiveness at watershed scale. Austrian collaborator is well known public institute in water and life sciences. Except for serious dispute among the communities, the delay in project implementation is not expected. Considering all the above-mentioned factors, the probability of success of this project is very high.

8.   Intellectual Property Rights

No patentable results are expected from this project. The biosafety standards do not apply to the proposed work.

9. References

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