Food Security Coordination & Disaster Prevention Office
Bureau of Agriculture and Rural Development
The Government of Amhara National Regional State
The Federal Democratic Republic of Ethiopia

THE DEVELOPMENT STUDY
ON
THE IMPROVEMENT OF LIVELIHOOD
THROUGH
INTEGRATED WATERSHED MANAGEMENT
IN AMHARA REGION

FINAL REPORT

March 2011

Japan International Cooperation Agency
SANYU CONSULTANTS INC.

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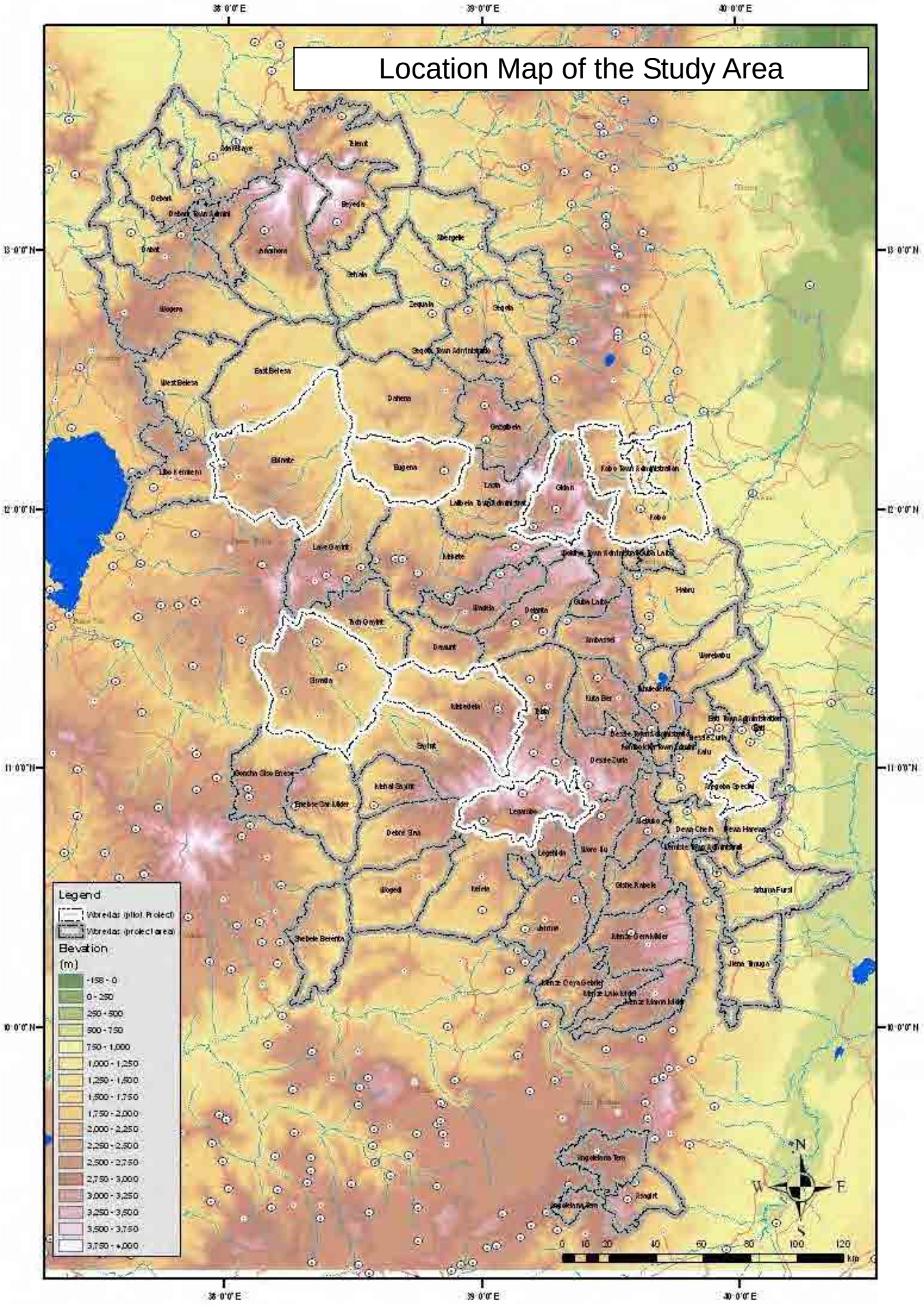
Location Map of the Study Area
38°0'0"E
39°0'0"E
40°0'0"E
13°0'0"N
12°0'0"N
11°0'0"N
10°0'0"N
Legend
Woredas (pilot Project)
Woredas (project area)
Elevation (m)
-158 - 0
0 - 250
250 - 500
500 - 750
750 - 1,000
1,000 - 1,250
1,250 - 1,500
1,500 - 1,750
1,750 - 2,000
2,000 - 2,250
2,250 - 2,500
2,500 - 2,750
2,750 - 3,000
3,000 - 3,250
3,250 - 3,500
3,500 - 3,750
3,750 - 4,000
0 10 20 40 60 80 100 120
km
N
W
E
S

Summary

1. INTRODUCTION OF THE STUDY

Amhara National Regional State (ANRS) located in the northern part of the Federal Democratic Republic of Ethiopia has the area of about 154 thousand sq. km. accounting for around 15% of the territory of the nation where about 17.9 million (or about 25% of the national population) are inhabited. In the ANRS, 6.3 million people are considered as food insecure. In particular, the eastern area of Amhara Region has been exposed to recurrent drought for past 3 decades, thus considered as the most suffering area from food shortage.

Under such circumstances, the Federal Government of Ethiopia requested cooperation of Japan for "The Development Study on the Improvement of Livelihood through Integrated Watershed Management in Amhara Region". Based on this request, Japan International Cooperation Agency (JICA) dispatched a preparatory study team to Ethiopia in March 2007 and agreed the basic contents of Scope of Work (S/W) that were signed between the ANRS Government and JICA in the same month. Under such background, JICA dispatched a Study Team to the ANRS from March 2008 to conduct the Study as described in the S/W.

The overall goal of the Study is to ensure food security of the vulnerable households in food insecure area of Amhara Region through implementation of integrated watershed management. The objectives of the Study include the following two items:

- To formulate development plans for the extension of appropriate watershed management and rural development in food insecure area through implementation of verification project.
- To carry out capacity development of Ethiopian counterpart personnel as well as communities concerned in the course of the Study

The target area of this Study encompasses the 64 Woredas having chronically been suffering from food deficit out of 151 existing Woredas in ANRS. These target Woredas are located in the central to the eastern side of the region. Also, the target areas of formulating Woreda development plan and of implementing verification project include 8 Woredas (Ebinate, Simada, Bugena, Gidan, Kobo, Aregoba, Mekedela and Legambo, refer to the location map of the Study Area) out of the 64 Woredas.

2. PRESENT SITUATION OF AMAHARA NATIONAL REGIONAL STATE

ANRS is the second most populated region in Ethiopia, following to Oromia. Currently, the annual population growth rate is estimated between 2.34 – 3.10%. Even if the medium rate of population growth (2.72%) is applied for projection, the population size of the region will double in 26 years. The population density is 118 persons/km^2. The highlands are more densely populated than the lowlands. With respect to age structure, 54.8% are under 19 and 4% are greater than 65 years old.

Whilst the agricultural sector is the dominant economic sector like other regions in the country, the share has been shifted from agriculture to industry and service sector as the recent trend. About 88.6 % of the regional population resides in rural areas and engaged mainly in agriculture / subsistence farming.

The average of life expectancy at birth is 54 years. However, owing to the prevalence of HIV/AIDS pandemic and other infectious diseases, life expectancy is expected to become even shorter. The infant mortality rate is 94/1000 live births and the less than five mortality rate is 154/1000 live births. In respect to the gross enrollment ratio in primary school (1-8 grade) is 99.8% (BoFED, 2009), and secondary school (9-10 grade) is about 38.3%. The regional water supply coverage is 58%. The total road network of the region is about 6,340km, which makes the regional road density 41m per km^2. In respect to religion, 82.5% of the population is Ethiopian Orthodox Christians, 17.2% of Muslims, and 0.2% of Protestants. In urban areas, the percentage of Muslims increases. Concerning ethnicity, 91.5% of population is found to be Amharic in the region and Amharic is widely spoken as the official language.

In 2009, the total revenue of the region increased 41% compared to the year 2008. However, the revenue derived from the region is far behind its annual expenditure. Currently, nearly 80% of regional budget is originated from federal transfer and donor assistance. As for the budget allocation, economic and social sectors represent more than two thirds of the total budget.

In ANRS there are 64 food insecure Woredas, which represents 42.4 % of the total Woredas. As for the rural Kebeles, 49 % of them are food insecure whereas 31 % are so for urban Kebeles. Among the 11 Zones including Bahir Dar Town, more than 90 % of total Kebeles are food insecure in North Wollo, Oromiya, Wag Himera and South Wollo Zones.

3. PRESENT SITUATION OF THE 64 FOOD INSECURE WOREDAS

Natural Environment

The elevation of the 64 Woredas ranges from 572 m above sea level at Artuma Fursi Woreda, to 4,520 m at Ras Dashen in Janamora Woreda. The area of 64 Woredas is classified into 5 zones according to the Ethiopian agro-climatic zones. Most areas are classified into Weyna Dega and Dega zones, which accounts for 48.3 % and 30.6 % of the total area respectively. Only one third of the area can be categorized to the sloping land below 8 %. The most dominant soil type is Lithosols which consist of more than half of the 64 Woredas. Lithosols have thin soil in thickness properties. The annual soil loss is estimated at as much as 11.5 mm on average.

The western half of the Study Area has two distinct seasons; wet from June to September and dry from November-February, and the eastern half has two rainy periods and one dry period; the main “Kiremt” rain from June to September, small “Belg” rains form March to May, and dry “Bega” from October to February. There is a variety of climatic zones in the 64 Woredas. Most parts of the area are under subtropical and temperate zones, and the remaining are tropic or boreal zones. The temperature in the area is mainly related with altitude and the Study Area has a considerably wide range of temperature differences mainly due to its variations in elevation.

The surface water is available mostly during rainy season but its availability in amount and duration are relatively limited. The base flow water runs off slowly in long duration with relatively large amount. Although this base flow is usually one of the most reliable natural water resources for human,

it is very difficult to develop artificially. Basalt is the dominant foundation of rock and aquifer in the basalt is not so developed. Basically, the available location of the groundwater is quite limited. The most common water source for domestic use is unprotected spring. Other sources are developed spring and river. The most common source of potable water is developed spring followed by tap water.

The most dominant vegetation type of the 64 Woredas is cropland, 65.1 % of the total. Woody vegetation, which includes evergreen, deciduous and open forests and shrub, accounts for only 15.2 % while grassy vegetation for 19.3 %. Wood accounts for the largest amount of the primary source of fuel, 65.1 %, followed by dung of 19.7 %. However, this rate differs significantly according to the Woredas.

Socio-economy

In the 64 Woredas, the average gross enrolment rate in primary school is 64.4% for male, 56.3% for female and 60.6% for the total. As for the illiteracy rates, male figure (64.3%) is lower than women (72.9%). The socio-economic survey done by the Study in 2008 revealed that adult mortality rate in the 64 Woredas was 9% on average. Since the regional average was 6.15%, the Study Area faced a severe condition.

In the Study Area, the road network has not yet well developed. There are two trunk roads running from north to south, which pass on only 14 Woredas. Also there are four link roads and one main access road running. Among the 64 Woredas, there are 10 Woredas where no major roads are running on their territories. In addition, electrification coverage in the Study Area is still very low, around 2%. As for the population coverage of the water supply, it is still 43.5%.

According to the wealth ranking conducted in 2008, the distribution of the poor and very poor was the highest in Gidan (100%) followed by Ebinate (85%) and Bugena (82%). On the other hand, in Simada and Kobo, people seemed that the poor and very poor occupied 60%. Gender-based discrimination, lack of protection of basic human rights, violence, lack of access to productive resources, education and training, basic health services, and employment are widespread in the Study Area, too.

Agriculture and Livestock

The average holding size of farmland in the Study Area is estimated to be 0.93 ha/farm household and is smaller than that of 1.10 ha in ANRS. The distribution of soils with shallow effective depth due to natural and accelerated erosion in the past is one of the most serious agronomic constraints in the Study Area.

In the Study Area, crops grown are mainly cereals, pulses and oil crops. Root crops are less important and production of vegetables and permanent crops are very limited. Because of the wide range of agro-climatic zones, varieties of crops are grown.

The most important climatic limitation for crop production in the Study Area is a rainfall pattern. It ranges from over 1,200 mm/year in the southeast to less than 700 mm/year in the northeast and is not well distributed throughout a year concentrating in a three-month main rainy season, peaking in July and August. Cropping systems adopted by farmers involve a wide range of crops and differ from one

locality to another. Mixture of crops grown is selected to meet needs of farmers and cropping calendars are designed to spread their workloads. It seems that temporary crop production in the belg season is commonly practiced in Legambo and Gidan while a single cropping in the meher season is prevailing in other Woredas. Production of permanent crops is rather limited compared to the temporary crops in the 8 target Woredas as shown in the following table.

The yield levels of temporary crops in the Study Area are still low compared with the potential yield levels due to traditional farming practices and rainfed conditions. The yield levels of belg crops are miserably low due possibly to drought or water shortage in the season.

From the production volumes of cereals, the 8 target Woredas can be grouped into 5 groups by a combination of primary and secondary cereals as follows;

Primary Crop – Secondary Crop				
Teff – Barley	Barley – Wheat	Sorghum – Teff	Teff – Wheat	Teff – Maize
Bugena, Mekedela	Gidan, Legambo	Kobo, Kalu(Aregoba)	Ebinate	Simada

Irrigation developments in the 8 Woredas are rather limited except Mekedela and the small-scale river diversion system is a mainstay.

The livestock sub-sector is another important economic activity for farm households in the Study Area. Livestock husbandry in the areas is still at the stage of rather less intensive being placed priority on number of animals rather than productivity. Draft cattle are primary sources of labor for land preparation and transport of farm products. Cattle are generally stocked as assets and small ruminants are usually kept to cope with food insecurity.

There are 8 research centers operated in ANRS under the coordination of ARARI but they have problems on finance and research instruments/facilities. The current extension system is composed of three tiers of government administrative structures: federal, region and Woreda including DAs and FTC. However, capabilities and experiences of the DAs are rather limited in many cases because of rapid deployment of newly recruited college graduates.

As for the seed production and distribution system in ANRS, the seeds produced by the producers are usually distributed through agricultural cooperatives and cooperatives unions to farming communities. Farm inputs supply to farming communities is under the hand of public enterprises.

Major agricultural commodities marketed in the region include cereals (teff, barely, wheat, maize, and sorghum), live animals and oil seeds. Due to the dominance of rain-fed agricultural production, market depends primarily on the major harvest season from November to December.

Satellite Image Analysis

With the comparison between Landsat 1980 and 1999/2000 images, the composition of land cover was not drastically changed, of which 35 to 34% of forest/shrubs and 32 to 33 % of cultivation. In comparison with the Landsat 2000 and MODIS 2008 images, coverage of forest/shrubs decreased by 15 %. According to the SWAT analysis, the gross soil loss ranges 1 to over 40 mm/year with 10 mm/year average in the Study Area.

Categorization of the 64 Food Insecure Woredas

Considering the annual rainfall and elevation, the 64 Woredas are categorized into six zones. The most common zone is Moist Weyna Dega, which includes 19 Woredas, followed by 17 of Moist Dega, and 13 of Dry Weyna Dega. However, normally a Woreda includes a wide range of elevation and rainfall and a Woreda consists of 3.5 traditional agro-climatic zones on average. Even though the 64 Woredas can be classified into the six zones according to the agro-climatic zones, this result should be utilized with understanding of this point.

For the socio-economic viewpoint, categorization of the 64 food insecure Woredas was conducted with the data of: (i) demographic data for main indicators of human activities, (ii) road, electrification and rural water supply data for main indicators of economic infrastructure, (iii) education and health data for main indicators of basic human needs conditions, and (iv) roof material and associations data for main indicators of rural society.

Categorization of the 64 Woredas based on the present agricultural conditions was made by five main agricultural characteristics. The characteristics employed include: i) prevailing farming system, ii) annual cropped area of temporary crops per farm household, iii) primary and secondary temporary crops cultivated, iv) extent of temporary crops cultivation in belg season, and v) holding size of livestock per household.

4. FORMULATION OF THE WOREDA DEVELOPMENT PLANS

After the workshops at analytical stage from April through September 2008, a series of workshops for Woreda development and project designing were held at Woreda level. The first 2-day workshops in October, November and December 2008 were for: 1) sharing sector-wise Woreda development plans, 2) identifying approaches, strategies, programs and projects for the development of the said Woreda, and 3) prioritization of all the approaches, strategies, programs and projects. During the second 1 or 2-day workshops, 1) the list of approaches, strategies, programs and projects were amended and new project ideas were included, 2) prioritization was amended, and 3) outlines of the priority projects were designed.

In all the Woredas, food was the highest priority (34.1 % to 24.7 %) except Aregoba (22.3 %), where infrastructure (27.6 %) was No.1. Health was the second highest priority in Ebinate, Bugena, Kobo and Mekedela Woredas (19.3 % to 16.6 %), while it is the third highest priority in Simada, Gidan, Legambo and Aregoba Woredas (18.6 % to 14.9%). Infrastructure was high priority in Aregoba, Simada, Mekedela and Bugena Woredas (27.6 % to 13.8 %), but not so high in Kobo, Ebinate and Legambo Woredas (10.8 % to 7.8 %). Environment was relatively high in Legambo, Kobo and Bugena Woredas (16.7 % to 14.8 %), but very low in Aregoba and then Ebinate (4.8 % and 9.7% respectively). Gender (8.3 % to 2.2 %) and cash (11.3 % to 7.3 %) were relatively low in all the Woredas. (For the detailed and revised development plans for the 8 Woredas, please refer to the texts and Appendix E.)

5. VERIFICATION PROJECT

Verification Project had been implemented in the 8 model watersheds in the 8 target Woredas since

April 2009 so as to get various experiences throughout the project implementation period. It was comprised of three components, namely agricultural promotion, natural resource management and livelihood improvement. In addition to the training budget (about 286,000 Birr), about 2.6 million Birr was disbursed for the direct cost of the Verification Project. (Agricultural promotion component: 999,000 Birr, Natural resource management component: 648,000 Birr, Livelihood improvement component: 906,000 Birr)

The major key stakeholders of the Verification Project included i) participating people (local residents who did various activities), ii) Development Agents (agriculture, livestock and natural resources), and iii) Kebele/Woreda officers related to the activity/component.

Agricultural Promotion Component

The verification activities for agricultural promotion (APVAs) were planned and implemented: i) to verify the adoptability of the proposed approaches for agricultural promotion in the food insecure Woredas formulated in the present Study, ii) to assess the capabilities of WAOs and DAs for implementing APVAs, and iii) to evaluate performances, results and findings of individual APVAs in the target watersheds and to extract lessons learned from the implementation of APVAs.

The formulation of the preliminary proposed/conceived verification activities for agricultural promotion was made through the participatory approach of stakeholders, WAO, DAs, watershed community & the Study Team. The following 21 activities were implemented in the 8 model watersheds.

1. Demonstration/Verification Plot: Primary Crops
2. Demonstration/Verification Plot: Secondary Crops

3.1 Simple Trial on Promising Crops & Farming Practices

3.2 Simple Trial (in collaboration with RCs)

4. Fruit Production Campaign
5. Preliminary Trial on Agro-forestry
6. Sunflower Production
7. Forage Development (surround of farmland)
8. Hillside Forage Development
9. Sheep Breed Improvement
10. Small-scale Fish Farming
11. Introduction of AI Service
12. Veterinary Services Strengthening
13. Kebele Veterinary Agent Training
14. Inset Processing Training
15. IPM Training
16. Watershed Community Vegetable Nursery Development
17. Women Association Strengthening
18. Sheep Fattening

19. Modern Bee Hive Package
20. Small-scale Poultry Farming Promotion
21. FTC Farm Improvement

The numbers of APVAs implemented by WAO are 48, 16 and 32 activities respectively in the meher season 2009, belg season 2009/10 and meher season 2010. In total, 21 different activities were implemented by WAO and cumulatively 96 APVAs were implemented in the 8 target watersheds.

Natural Resource Management Component

Since the problem of forest degradation and soil erosion are critically serious in the target areas, the project put emphasis on the recovery of vegetation and soil and water conservation by creation of physical structure through human resource development. The activities are divided into the following five categories.

1. Production of Tree Seedling
2. Afforestation
3. Soil and Water Conservation Structure
4. Gully Rehabilitation
5. Capacity Building

The main purpose of the activities are to verify these natural resources management activities from the viewpoints of technical and social aspects: suitability of tree species in different watersheds, appropriate design of soil and water conservation structures, implementation organization of community tree nurseries, and others.

Livelihood Improvement Component

The livelihood improvement component was composed of various kinds of activities since it included the activities related to people's livelihoods in each Woreda. The selection of the activities was done according to the following processes: i) issuance of request letter and explanation to the 8 target Woredas, ii) discussions of the proposed activities and planning with the related offices, and iii) selection of the activities for livelihood improvement component. Through the discussions with the offices concerned at each Woreda, 11 activities for the livelihood improvement component were selected as shown below.

1. Aquaculture for youth association support (Ebinate)
2. Improved heifer introduction for HIV/AIDS association support (Ebinate)
3. Spring & hand dug well development (Simada)
4. Roof rainwater harvesting facilities (Bugena and Aregoba)
5. Ewe keeping training for women (Gidan)
6. Business skill training for PLWHA people (Gidan)
7. Vocational training (carpentry, sewing and brick production) (Gidan and Kobo)
8. Gender mainstreaming (Kobo)
9. School support (construction, library and hand dug well) (Kobo and Mekedela)

10. Business shed construction for youths (Legambo)
11. Goat fattening training for jobless people (Aregoba)

These activities can be classified into five types of activity, namely business (6, 7, 10), livestock (1, 2, 5, 11), education (9), gender (8) and water related activities (3, 4).

Good Practices Introduction

Scope of the Works for this Study between JICA and ANRS did not include the good practices introduction. The idea came out in July 2008 after the steering committee meeting for the explanation of the Progress Report (1). During the planning workshops for Woreda development plans held in October and November 2008, ideas on good practices were suggested and the following three activities were finally implemented.

1. Fuel-saving Stove Extension (For the 8 Woredas)
2. Basic Meteorological Survey (For the 8 Woredas)
3. Vegetable Farming in Irrigable Area in Dry Season (Legambo)

Participatory Final Evaluation

The final participatory evaluation workshops of the verification projects on the ground started at Silasiemesk Watershed, Ebinate Woreda, South Gondar Zone on 20 October 2010 and completed at Aregoba Woreda, South Wollo Zone on 26 and 27 November. Then the region-level final evaluation workshop was held on 19-20 December with 90 participants. The number of participants at nine watershed level workshops totaled 448, and that at eight Woreda level workshops totaled 251.

The main objective of the final participatory evaluation is learning-oriented evaluation by all the stakeholders involved in the verification project. In the final participatory evaluation workshops, the participants were asked to describe the activities of the verification project implemented and the issues arose. Then they were asked to evaluate the achievement of the verification activity in terms of (1) Effectiveness and why. After discussion, they were asked to evaluate also (2) Validity and (3) Sustainability of the verification activity.

(1) Effectiveness means how much expected results they have achieved. The participants were asked to evaluate qualitatively by four levels: Very Good-4, Good-3, Not So Good-2 and Not Good-1. (2) Validity means whether the verification activity is still valid or not. It was also by four levels: Very Good-4, Good-3, Not So Good-2, and Not Good-1. (3) Sustainability means that the verification activity can be disseminated in the community and neighboring communities. It was also evaluated by four levels: Very High-4, High-3, Medium-2, and Low-1.

The evaluation results were quite consistent among the 8 Woredas and (1) Sheep Breeding Improvement / Fattening, (2) Horticulture (Vegetable Production), and (3) Forage Development (Hillside) of Agricultural Promotion Component and (1) Natural Resource Management (Gully Rehabilitation and Terracing), and (2) Improved Fuel Saving Stove of Natural Resource Management Component had higher scores.

At watershed-level workshops, Primary School Construction Support had higher scores. And at

Woreda-level workshops, Training in Inset Processing and Production, Ewe Keeping for Women, Business Skill for PLWHAs, Poultry Production, Brick Production and Sewing, and Construction Support in Primary School, Library and Business Shed had higher scores.

As for the comparison of final evaluation results for Agricultural Promotion and Natural Resource Management Components by zones, validity and sustainability of Sheep Breed Improvement / Fattening, Improved Fuel Saving Stove and validity of Natural Resource Management were Very Good / Very High across the three zones. Validity & sustainability of Crop Production and Horticulture were Very Good / Very High in South Wollo Zone, and sustainability of Fruits Trees, and validity of Modern Beehive Development were Very Good / Very High in South Gonder Zone. Validity of Forage Development (Farmland), Forage Development (Hillside) and Tree Planting was Very Good in North and South Wollo Zones.

6. TECHNICAL TRANSFER

The Study Team prepared the plan of technical transfer in April 2008. However, the frequent turnover of Woreda officers and DAs became an obstacle for effective technical transfer. To ease the negative impacts of high staff turnover, the Technical Committee was organized at each Woreda, but it didn't properly function in some Woredas.

Based on the plan, technical transfer was conducted. Major technical transfer items include: training of energy efficient improved cooking stove, field guidance by Sirinka Research Center, gabion construction for gully rehabilitation, meteorological data collection, measurement of stream discharge, micro basin preparation for seedlings, field guidance on land preparation & planting in demonstration & trial plots, technology transfer through field monitoring activities, and measurement of reservoir sediment and formulation of its removal plan.

7. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The Woreda development plans for the 8 target Woredas were formulated in the course of the Study through the active participation of Woreda officers from various sector offices. Because it is considered as comprehensive Woreda development plans containing various development approaches/strategies/programs based on the current situation analyses, the 8 target Woredas should go into actions: (1) to prioritize/merge/coordinate these approaches/strategies/programs and (2) to mitigate the core problem, "the life of people in the Woreda is difficult.". In addition, the regional government should expand and promote the participatory planning approach adopted in the Study to other food insecure Woredas because it seemed to be effective and useful for planning.

Through the implementation of many verification project activities from early 2009 to late 2010, many activities which were effective in rural development were identified and they were highly evaluated by zone/Woreda staff as well as local people. The 8 target Woredas should promote and expand the highly evaluated activities. In the future, the regional government should diffuse these good practices to other food insecure Woredas taking into account of natural/socio-economic situations there.

Recommendations for the ANRS 1: Formulation of Woreda Development Plans

In general, most Woredas have sector-wise plans but there are no comprehensive plans which cover all the sectors. During the Study period, a participatory approach that was based on a series of discussions with various participants in the workshops was adopted for the Woreda development plan formulation. Although the method used in the course of the Study is not the only method for planning, it is important for the Woreda development plan formulation to incorporate devises to reflect opinions of stakeholders in order to make more practical development plans based on the actual situations.

Recommendations for the ANRS 2: Continuation of Good Practices

Through the verification projects during the Study period, many activities were assessed as highly effective by many officers and it is expected that these good activities are being continuously practiced and expand to other areas. As for the possible budget sources for the continuation of good practices, reorganization of the current budget resource seems to be practical.

Recommendations for the ANRS 3: Linking Several Components

Because of the expertise of Development Agents and the Study Team members, verification project activities were classified into three components, namely, agricultural promotion, natural resource management and livelihood improvement. However, in the real livelihoods in villages they are combined together and intertwined. This means that these activities should be linked and implemented in concert. Linking several components with multi-propose facilities is another option.

Because the WAO and development agents can cover issues on both agriculture and natural resource, the linking of the AP and NRM components seems to be easier. However, some activities of the LI component (e.g. vocational training, education, etc.) are out of WAO coverage and joint works with other sector offices are indispensable. For the smooth linking with other sector offices, it is very influential to have acknowledgements and instructions of Woreda Administrator and/or region/zone officials for joint works.

Recommendations for the ANRS 4: Organizational Structure for Better Project Implementation

In Ethiopia, organizational structure of local administration is generally sector-wise. However, a Woreda Administrator does not belong to any sector offices and is very influential with all the administrative services and development interventions within the Woreda as a responsible person. In the future, it is better to have acknowledgements by Woreda Administrator on any multi-sector development interventions for the establishment of competent organizational structure in project implementation.

If Woreda Coordination Committee chaired by the Woreda Administrator is organized and held periodically (e.g. once in two months), it is useful to establish an organizational structure that allows more stakeholders and Woreda staff to monitor the implementation of various projects. It is also recommendable to continue the similar implementation structure, which local people participate various activities according to the initiatives/guidances of the Woreda officials and DAs. However, it also observed that many of these frontline workers don’t have enough technical knowledge; hence,

capacity development for them is urgently necessary.

Recommendations for the ANRS 5: Much emphasis on Qualitative Aspects

In general, it seems that many natural resource management programs/projects in the Study Area put much emphasis on quantitative targets rather than qualitative ones. The Study Team considers that much emphasis should be put on the qualitative aspects. Because the construction quality of some of the soil and water conservation structures was not regarded as good, it was expected that those structures didn't function properly or lose their functions very soon.

Therefore it is important to improve the construction level of the structures; hence, capacity development of construction site managers is indispensable. In addition, maintenance and repair activities for these structures should be introduced and promoted. Many structures were seen as degraded but it seemed that no maintaining activities had been done for these structures.

Recommendations for the ANRS 6: Logistics and Stores of Food for Regional Food Security

In the western part of ANRS, there are many food secure Woredas. If it is possible to transport enough volume of the excess food produced in these Woredas on time, less serious food shortage occurs in the food insecure Woredas located in the eastern part of ANRS. For the establishment of food transportation system, well-functioned logistics is indispensable. Storing capacity development is also crucial.

Recommendations for the ANRS 7: High Turnover of Local Governmental Staff

It is true that many Development Agents and Woreda staff try to change their jobs to seek better living conditions in towns and urban areas. This might result from the fact that the living conditions in rural Kebeles/Woredas were still very primitive. Many DAs and Woreda staff who are frontline workers of local government don't have any incentives to continue working there. Therefore it is an urgent matter to take appropriate measures (e.g. introduction of remote allowance, provision of staff houses) to stop outflow of human resources, otherwise no continuous activities cannot be done for the rural development in ANRS.

Recommendations for the Donor Organizations: Collaboration with Others for the Target Field

In ANRS, there are various bilateral and multilateral donors working in the field of agricultural/rural development and natural resource/watershed management. To have more fruitful results in the field of agricultural/rural development and natural resource/watershed management, it needs to share the information/lessons learned from these similar activities. In addition, coordination of the donor interventions in terms of both spatial distribution as well as activity contents and collaborative works in various activities by different organizations are very helpful to improve the effectiveness of each aid intervention.

8. FUTURE PROJECT PROPOSALS

Based on the knowledge gained through the study, future project proposals are outlined by three subsectors as shown below.

Agricultural Promotion Subsector

- Integrated Agricultural Promotion Project in the Food Insecure Woredas in Amhara Region
- Temperate Fruit Development Project in Ethiopian Highlands

Natural Resource Management Subsector

- Environmental Information Analysis of Watersheds
- Community-based Forestry Promotion
- Silvicultural Technology Improvement and Capacity Building
- Watershed Conservation Technology Improvement and Capacity Building

Livelihood Improvement Subsector

- Livelihood Improvement Project for Rural Women
- Self-support Project for People Living with HIV/AIDS
- Road Construction for Rural Area Network Project
- Project for Effective Utilization of Rainwater

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Abbreviations

ADLI	Agricultural Development Led Industrialization
ANRS	Amhara National Regional State
APVAs	Verification Activities for Agricultural Promotion
ARARI	Amhara Regional Agricultural Research Institute
ARC	Agricultural Research Center
ARRA	Amhara Rural Road Authority
ATVET	Agricultural Technical & Vocational Education Training
BAFOALRC	Bahir Dar Fishery & Other Aquatic Life Research Center
BAMaFSRC	Bahir Dar Agricultural Mechanization & Food Science Research Center
BoARD	Bureau of Agriculture and Rural Development
BoFED	Bureau of Finance and Economic Development
BoWRD	Bureau of Water Resources Development
CACC	Central Agricultural Census Commission
CRG	Community Research Group
CSA	Central Statistic Agency
DAs	Development Agents
EGTE	Ethiopian Grain Trade Enterprise
EPLAUA	Environment Protection, Land Administration & Use Authority
EPP	Extension Package Programs
ERA	Ethiopian Road Authority
ESE	Ethiopian Seed Enterprise
FFD	Farmer Field Day
FSCDPO	Food Security Coordination & Disaster Prevention Office
FSP	Food Security Programme
FTC	Farmer Training Center
GIS	Geographic Information System
HTPs	Harmful Traditional Practice
ICM	Integrated Crop Management
IPM	Integrated Pest Management
ISLA	Information System of Land Administration
ITCZ	Inter-Tropical Convergence Zone
JALIMPS	JICA/Amhara Livelihood Improvement Study (Abbreviation of this Study)
KVAs	Kebele Veterinary Agents
LU	Livestock Unit
MoARD	Ministry of Agriculture and Rural Development
NSC	National Seed Council
ORDA	Organization for Rehabilitation and Development in Amhara (NGO)

PADEP	Participatory Demonstration & Extension Program
PADETS	Participatory Demonstration & Extension Training System
PLWHA	People Living With HIV/AIDS
PSNP	Productive Safety Net Program
RARIs	Regional Agricultural Research Institutes
RC	Research Center
SME	Small and Micro Scale Enterprise Office
SWAT	Soil and Water Assessment Tool
TC	Technical Committee
WAB	Women Affairs Bureau
WAO	Woreda Agriculture and Rural Development Office
WBISPP	Woody Biomass Inventory and Strategic Planning Project
ZAO	Zonal Agriculture & Rural Development Office

CHAPTER 1 INTRODUCTION OF THE STUDY

1.1 Background of the Study

Amhara National Regional State (hereinafter referred to as ANRS) located in the northern part of the Federal Democratic Republic of Ethiopia (hereinafter referred to as Ethiopia) has the area of about 154 thousand sq. km. accounting for around 15% of the territory of the nation where about 17.9 million (or about 25% of the national population) are inhabited. Out of the total population inhabited in this Region approximately 3 millions of people have been suffering from chronicle food shortage, having failed to secure their minimum food requirement for years. Adding other casual food-deficit population counting 3.3 million to this, people of 6.3 million in total are under food insecurity.

In particular, the eastern area of Amhara Region has been exposed to recurrent drought for past 3 decades, thus considered as the most suffering area from food shortage. Food shortage in this area has emerged from various inter-related and chain-reacting causative factors including: (1) low farming techniques, (2) excessive land reclamation/destructive over-felling of forests with fast demographic growth, (3) soil erosion by runoff concentrated in a short time, (4) vulnerability towards droughts under rain-fed farming relying only rainfall, (5) soil degradation by overgrazing of livestock, and (6) difficulty in securing foods due to low household income.

Under such circumstances, the Federal Government of Ethiopia requested cooperation of Japan for "The Development Study on the Improvement of Livelihood through Integrated Watershed Management in Amhara Region". Based on this request, Japan International Cooperation Agency (hereinafter referred to as JICA) dispatched a preparatory study team to Ethiopia in March 2007 and agreed the basic contents of Scope of Work (S/W) that were signed between the ANRS Government and JICA in the same month. Under such background, JICA dispatched a Study Team to the ANRS from March 2008 to conduct the Study as described in the S/W.

1.2 Objectives of the Study

The overall goal of the Study was to ensure food security of the vulnerable households in food insecure area of Amhara region through implementation of integrated watershed management. The objectives of the Study included the following two items:

1. To formulate development plans for the extension of appropriate watershed management and rural development in food insecure area through implementation of verification project.
2. To carry out capacity development of Ethiopian counterpart personnel (C/P) as well as communities concerned in the course of the Study

1.3 Organizational Framework of the Study

The Study had been implemented by joint work of the JICA Study Team and the counterpart organizations at the regional level, namely Food Security Coordination & Disaster Prevention Office (herein after referred as FSCDPO) and Bureau of Agriculture and Rural Development (BoARD). In principle, the FSCDPO was responsible for coordination of the Study, while the BoARD was

responsible for implementation of the Study. Because activities for verification project were implemented at the community level in the 8 target Woredas, joint work with local people and the officers at the Woreda and Kebele levels were important and indispensable for success of the verification project activities.

Also, a steering committee was established at the regional level when the Study commenced. Members of the steering committee include; Bureau of Finance and Economic Development (BoFED), Women Affairs Bureau (WAB), Bureau of Water Resources Development (BoWRD) and Environment Protection, Land Administration & Use Authority (EPLAUA). There had been steering committee meetings seven times so far.

	Date	Subject	Number of Participants				
			Region	Zone	Woreda	Other	Total
1.	12 March 2008	Discussions on Inception Report	8	0	15	8	31
2.	25 July 2008	Discussions on Progress Report (1)	17	4	16	7	44
3.	1 April 2009	Discussions on Interim Report	14	3	15	11	43
4.	13 July 2009	Discussions on Progress Report (2)	15	3	0	6	24
5.	15 March 2010	Mid-term Evaluation of Verification Project (Discussions on Progress Report (3))	6	5	16	15	42
6.	21 December 2010	Final Evaluation of Verification Project * Discussions on Progress Report (4)	14	0	0	9	23
7.	9-16 February 2011	Discussions on Draft Final Report **	22	22	8	3	55

Note: * Final evaluation workshop at the regional level was conducted on 19 and 20 December 2010 with participants from the 8 target Woredas.
** Discussions on draft final report were conducted at Dessie, Weldia and Debre Tabor for the 3 zones and Bahir Dar for the region.

1.4 The Study Area

The target area of this Study encompasses the 64 Woredas having chronically been suffering from food deficit out of 151 existing Woredas in ANRS in Ethiopia. These target Woredas are located in the central to the eastern side of the region. Also, the target areas of formulating Woreda development plan and of implementing verification project include 8 Woredas (Ebinate, Simada, Bugena, Gidan, Kobo, Aregoba, Mekedela and Legambo, refer to the location map of the Study Area) out of the 64 Woredas. (See the Location Map of the Study Area in the beginning of this report.)

1.5 Overall Schedule

The Study consisted of two phases. In the phase I period, Woreda development plans (draft) were formulated in the 8 target Woredas through participatory planning workshops. The phase II included implementation of the verification project and review of the Woreda development plans by reflecting the lessons learnt from the verification projects. There was some overlapping period between the two phases. The total works were scheduled for 36 months, divided by 4 Japanese budgetary years as indicated in the following figure.

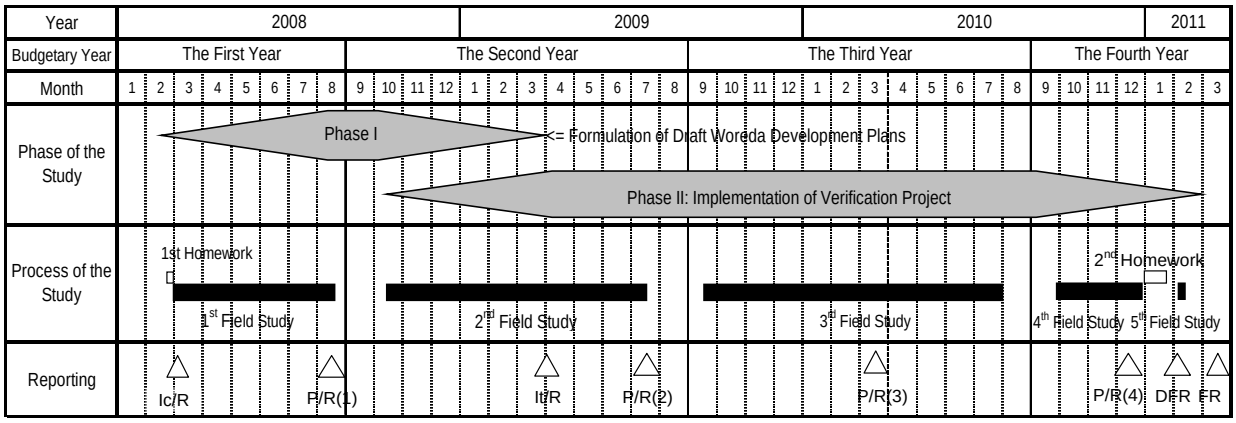


Figure 1.5.1 Overall Schedule of the Study

1.6 Overall Approaches

(1) Formulation of Woreda Development Plans

To formulate Woreda development plans (draft), opinions were collected through discussions with the various stakeholders including local residents, Development Agents and Woreda staff in the 8 target Woredas. Participatory process was introduced with a kick-off workshop at the regional level, followed by analytical and planning workshops at Woreda and community levels.

Community Workshop in Ebinate Woreda (6-7 May 2008)

(2) Verification Projects

The verification projects were implemented during the phase II period of the Study. They were characterized as trials not only to attain successful results but also to identify how activities were managed and what were successful and/or unsuccessful activities. Basically most verification projects were conducted within a model watershed, which was selected as a representative of each Woreda by Woreda Agriculture and Rural Development Office (WAO) prior to the implementation of Woreda level workshops in 2008. However, some verification activities for livelihood improvement component were performed out of the model watershed.

Senbo Model Watershed in Aregoba Woreda

CHAPTER 2 PRESENT SITUATION OF AMHARA NATIONAL REGIONAL STATE

Amhara National Regional State (ANRS) is one of the 9 regions in Ethiopia and is the second largest region. The region shares its boundaries with four other regions and one country; Tigray Region to the North; Oromia Region to the south; Afar Region to the east; Benishngul-Gumuz Region to the south-west; and Sudan to the west. ANRS is located 9-14 N and 36-40 E. It covers a total land of 154,049km^2 which is about 15% of the total areas of Ethiopia. The main organs of regional government are; executive, legislative, and judiciary. The region is administratively divided into 11 Zones (including Bahir Dar Special Zone), 128 Woredas (including Aregoba Special Woreda) and 23 Towns. Bahir Dar is the regional capital for ANRS.

2.1 Socio-economic Situations

(1) Population

ANRS is the second most populated region in Ethiopia, following to Oromia. The number of the population is estimated approx. 17.9 million in 2009, which accounts for almost a quarter of the total population of the country. Currently, the annual population growth rate is estimated between 2.34 – 3.10%. Even if the medium rate of population growth (2.72%) is applied for projection, the population size of the region will double in 26 years. The population density is 118 persons/km^2. The highlands are more densely populated than the lowlands. With respect to age structure, 54.8% are under 19 and 4% are greater than 65 years old. (Development Indicators of Amhara Region 2007/08, BoFED, 2009)

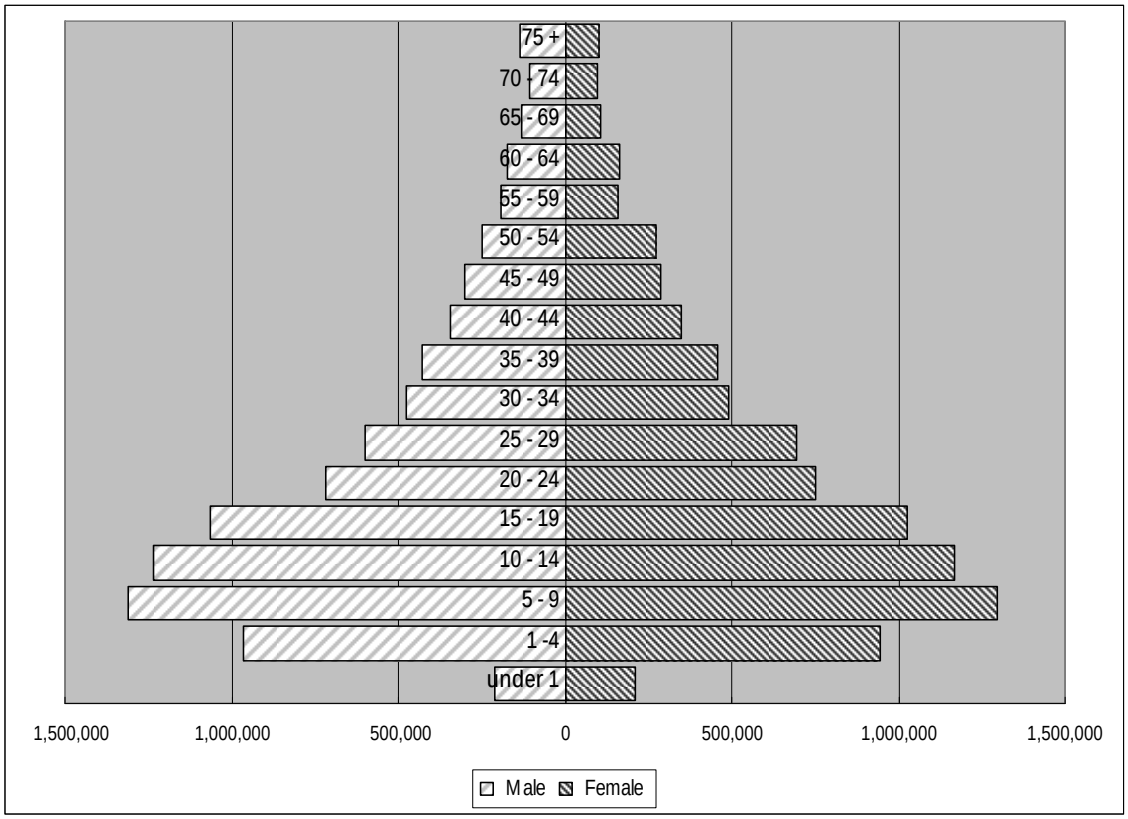


Figure 2.1.1 Population Pyramid of ANRS (2007)

(Data Source: Summary and Statistical Report of the 2007 Population and Housing Census Results, Population Census Commission, December 2008)

(2) Economy

The economic data have not been recently updated in the statistical booklet, Development Indicators of Amhara Region published by BoFED. The Regional Gross Domestic Product (RGDP) of the region in 2004/05 accounted for 57.9% from agriculture, 22.9% and 19.2% from industry and service sector respectively (BoFED, 2009). Whilst the agricultural sector was the dominant economic sector like other regions in the country, the share had been shifted from agriculture to industry and service sector as the recent trend. RGDP increased annually on the average by 5.1% over these years. In 2004, development growth rate of the region showed 7.92% and it was almost the same as national growth rate, 8%. The regional per capita income in constant annual cost in the year 1993/94-2004/05 increased from 664 Birr to 812 Birr (BoFED, 2009).

(3) Agriculture

About 88.6 % of the regional population resides in rural areas and engaged mainly in agriculture / subsistence farming. The region has genial weather and suitable land for livestock and crop production. It implies the potential to enables cereals, pulses, stalk crops, oil crops, fruits and vegetables to be cultivated. Animal husbandry is often practiced together with farming. In 2008, there were 12.7 million cattle, 9.0 million sheep, 6.0 million goats, and 13 million poultry in the region (BoFED, 2009). Approximately, 40% of all livestock in the country were found in this region. In spite of the potential of agriculture and the large number of livestock, the living standard in the region was low judging from estimated per capita income. In addition, the shortage of food was considered as a crucial issue for years in the region. In 2004, more than half of the household (56.7%) in rural areas could get food production to feed themselves for less than 9 months per year.

(4) Health

Fertility and mortality rates in the region were regarded as relatively higher than national average. The average of life expectancy at birth was 54 years. However, owing to the prevalence of HIV/AIDS pandemic and other infectious diseases, life expectancy was expected to become even shorter. Moreover, the infant mortality rate was 94/1000 live births and the less than five mortality rate was 154/1000 live births. Currently, there were 17 hospitals, 182 health centers and 2,619 health posts in the region (BoFED, 2009). It implies that one health post for 8,401 people, one health center for 119,105 people and one hospital for 2,012,882 people gave medical services.

(5) Education

In respect to the gross enrollment ratio in primary school (1-8 grade) was 99.8% (BoFED, 2009), and secondary school (9-10 grade) was about 38.3%. Average distance for a student to the nearest primary school was estimated about 3.15 km per one-way. In the region, there were about 330 kinder gardens, 5,682 primary schools (1-8), 179 general secondary schools, 83 preparatory schools, 4 teachers training colleges, 10 technical and vocational training colleges and 12 technical and vocational institutes. (BoFED, 2009)

(6) Water Supply

The region has several big rivers and three main watersheds, namely, Abay, Takeze and Awash watershed. In addition to the lakes, such as Tana Lake, there are several tributaries which do not dry up throughout the year. This shows that there is the potential of underground water. However, the performance of potable water supply and distribution remained at a low level. The regional water supply coverage was 58% (87% for urban and 54% for rural areas, BoFED 2009). This figure indicates that the 42% of the population did not reach the clean water. A great attention was required to the improvement of the water supply status for, in particular, rural households.

(7) Road Infrastructure

There were about 2,698.8 km of all weather roads under the jurisdiction of ARRA (Amhara Rural Road Authority) in the region. The total length of roads under ERA (Ethiopian Road Authority) was 3,641.3 km. The total road network of the region was about 6,340km, which made the regional road density 41m per km^2. It meant that in order to get to the main road, most people were compelled to take a long way to access public transportation. (BoFED, 2009)

(8) Culture and others

The people in Amhara naturally make much of cultural norms, belief and values. For instance, wedding, funerals, working in groups, respecting elderly and supporting the poor and other cultural practices are commonly exercised. On the other hand, several harmful traditional practices remains, such as FGM (Female Genital Mutilation), early marriage and tattooing which are associated with increasing the risk of HIV infection. In respect to religion, 82.5% of the population was Ethiopian Orthodox Christians, 17.2% of Muslims, and 0.2% of Protestants. In urban areas, the percentage of Muslims increases. Concerning ethnicity, 91.5% of population was found to be Amharic in the region and Amharic is widely spoken as the official language. (Summary and Statistical Report of the 2007 Population and Housing Census Results)

2.2 Financial Situations

In 2009, the total revenue of the region increased 41% compared to the year 2008. Probably, it was led by the new tax reform. However, the revenue derived from the region is far behind its annual expenditure. Nearly 80% of regional budget was originated from federal transfer and donor assistance. Even though the regional government had tried to secure its own revenue, the annual revenue generated within the region in 2008/09 was 853 million Birr covering only 17.1% of the total annual budget requirement.

As for the budget allocation, economic and social sectors represented more than two thirds of the total budget.

Table 2.2.1 Regional Budget Allocation in 2009

	Economic Sector (Birr)	Social Sector (Birr)	General Service (Birr)	Others Contingency (Birr)	Total (Birr)
Recurrent	597,031,957	1,817,695,254	1,079,038,296	273,932,179	3,767,697,686
Capital	630,191,619	281,709,744	297,901,683	0	1,209,803,046
Total	1,227,223,576	2,099,404,998	1,376,939,979	273,932,179	4,977,500,732

(Data Source: Development Indicators of Amhara Region 2007/08, BoFED, 2009)

The federal government grant is being allocated to the region based on a unit-cost on a top-down basis. The regional budget is approved by the Federal Council and then it is also allocated to each Woreda (block grant) and various bureaus/offices at the regional level based on a unit-cost analysis. The Woreda budget is approved by the regional council. The block grant allocated to each Woreda is then allocated to each sector activity in the Woreda by unit-cost based analysis which is approved by the Woreda council. Contingency reserves are retained at the regional level, and are normally between 5 % and 10 % of the total budget. They are reserved for the emergency as well as other unplanned expenditures. Reserving the contingency is not common at the Woreda level.

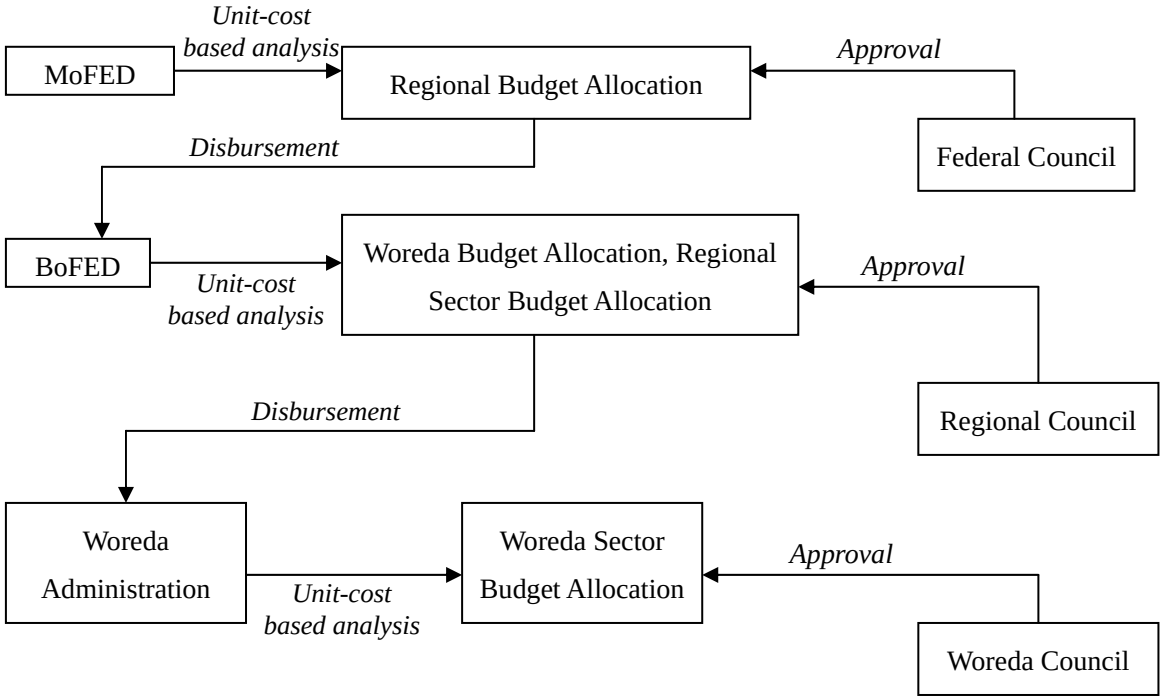


Figure 2.2.1 Chart of Government Budget Flow

According to the data obtained from BoFED for the 2009 Fiscal Year, the total budget allocation for the 8 target Woredas ranged 9.9 to 28.2 million Birr. Each Woreda's own revenue occupied less than 16 % and the block grant from the region represented 78-95 % of the total Woreda budget. Because the taxpayers are generally urban dwellers, the financial base is weaker in Woredas where there are a few urban areas.

Table 2.2.2 Budget Allocation of the 8 Target Woredas (2009 Fiscal Year)

Zone	Woreda	Total Budget Allocation for Woreda	Government Budget Allocation			Foreign Loan	Foreign Assistance
			Sub total	From the Woreda Revenue	From the Regional Government		
Amount (Birr)		1=2+5+6	2=3+4	3	4	5	6
South Gonder	Ebinate	25,487,648	24,050,669	4,068,000	19,982,669	599,889	837,090
	Simada	28,183,304	26,411,177	3,961,908	22,449,269	862,341	909,786
North Wollo	Bugena	13,019,620	12,958,563	962,289	11,996,274	0	61,057
	Gidan	23,064,129	21,859,596	2,309,642	19,549,954	661,877	542,656
	Kobo	24,200,217	22,945,621	3,887,686	19,057,935	0	1,254,596
South Wollo	Legambo	22,447,112	22,434,542	2,993,279	19,441,263	0	12,570
	Mekedela	19,988,217	19,804,191	2,480,150	17,324,041	0	184,026
	Aregoba	9,982,314	9,964,962	534,000	9,430,962	0	17,352
Distribution (%)							
South Gonder	Ebinate	100.0%	94.4%	16.0%	78.4%	2.4%	3.3%
	Simada	100.0%	93.7%	14.1%	79.7%	3.1%	3.2%
North Wollo	Bugena	100.0%	99.5%	7.4%	92.1%	0.0%	0.5%
	Gidan	100.0%	94.8%	10.0%	84.8%	2.9%	2.4%
	Kobo	100.0%	94.8%	16.1%	78.8%	0.0%	5.2%
South Wollo	Legambo	100.0%	99.9%	13.3%	86.6%	0.0%	0.1%
	Mekedela	100.0%	99.1%	12.4%	86.7%	0.0%	0.9%
	Aregoba	100.0%	99.8%	5.3%	94.5%	0.0%	0.2%

(Data Source: data obtained from BoFED)

2.3 Administrative Framework of ANRS

(1) Administrative Organs

Amhara National Regional State has various bureaus, authorities, agencies and offices under its administration. Currently, there are 38 organs (15 bureaus, 6 agencies, 5 authorities, 4 offices, 3 institutes, 3 commissions, 1 secretariat and 1 project) and 3 independent organs as shown below. Among them, 6 organs are the members of steering committee of this Study.

Table 2.3.1 List of Regional Administrative Organs

No.	Name of Bureau and Office	Remarks
1	Food Security Programme Coordination and Disaster Prevention Office	Counterpart Organizations
2	Bureau of Agriculture and Rural Development	
3	Bureau of Women Affairs	Steering Committee members
4	Environmental Protection and Land Administration & Use Authority	
5	Bureau of Water Resources Development	
6	Bureau of Finance and Economic Development	
7	Agricultural Research Institute	
8	Small and Micro-Enterprise Promotion Office*	
9	Bureau of Education	
10	Cooperatives Expansion Agency	
11	Bureau of Health	
12	Rural Roads Authority	
13	Bureau of Youth and Sports	
14	Bureau of Workers and Social Affairs	
15	Bureau of Urban Development	
16	Bureau of Trade and Industry	
17	Bureau of Justice	
18	Bureau of Information	
19	Bureau of Culture and Tourism	
20	Bureau of Capital Building	
21	Bureau of Administration and Security	
22	Technical and Vocational Education and Training Expansion Agency	
23	Rural Energy and Mining Resource Development Expansion Agency	
24	Mass media Agency	
25	Investment Expansion Agency	
26	Transport Authority	
27	Revenue Authority	
28	Park Conservation and Development Authority	
29	Regional President and Administration Council Office	
30	Penitentiary Administration Office	
31	Militia Office	
32	Police Commission	
33	Civil Service Commission	
34	Civil and Anti-Corruption Commission	
35	Management Institute	
36	City Plans Institute	
37	HIV/AIDS Secretariat	
38	Housing Development Project	
39	Bureau of Audit	Independent organizations
40	Regional Supreme Court	
41	Office of Spokes-person	

(Data Source: document from BoFED)

As of 2008, there were 187,917 (Male: 118,842, Female: 69,075) civil servants, which represented 1.47 % of the total population aged ten and over in the ANRS. Nearly 91 % of civil servants were Zone/Woreda staff while officers who work for regional institutions represented only 9 %.

In ANRS, there are 151 Woredas (including 23 Town Administrations) and 3,440 Kebeles in total under the 11 Zones (including Bahir Dar Special Zone) as of 2008. Among the all Kebeles, 313 (9 %) are categorized as urban Kebeles while the rest (3,127 Kebeles, 91 %) are as rural Kebeles.

(2) Food Insecure Woredas

Also there are 64 food insecure Woredas in ANRS, which represents 42.4 % of the total Woredas. As

for the rural Kebeles, 49 % of them are food insecure whereas 31 % are so for urban Kebeles. Among the 11 Zones including Bahir Dar Town, more than 90 % of total Kebeles are food insecure in North Wollo, Oromiya, Wag Himera and South Wollo Zones. On the other hand, there are no food insecure Woredas nor Kebeles in West Gojjam and Awi Zones.

Table 2.3.2 Distribution of Food Insecure Woredas and Kebeles in ANRS

Zone	No. of				No. of Food insecure				Distribution of Food insecure			
	Woreda	Kebele			Woreda	Kebele			Woreda	Kebele		
		Rural	Urban	Total		Rural	Urban	Total		Rural	Urban	Total
1 North Gonder	23	529	48	577	9	229	12	241	39.1%	43.3%	25.0%	41.8%
2 North Shewa	24	380	43	423	7	101	7	108	29.2%	26.6%	16.3%	25.5%
3 North Wollo	13	283	25	308	10	278	18	296	76.9%	98.2%	72.0%	96.1%
4 South Gonder	12	305	36	341	5	144	11	155	41.7%	47.2%	30.6%	45.5%
5 East Gojjam	18	386	37	423	3	89	4	93	16.7%	23.1%	10.8%	22.0%
6 Oromiya	7	101	8	109	5	100	7	107	71.4%	99.0%	87.5%	98.2%
7 West Gojjam	16	362	29	391	-	-	-	-	-	-	-	-
8 Wag Himera	7	121	6	127	6	120	6	126	85.7%	99.2%	100.0%	99.2%
9 South Wollo	21	470	48	518	19	459	32	491	90.5%	97.7%	66.7%	94.8%
10 Awi	9	181	21	202	-	-	-	-	-	-	-	-
11 B/Dar Town Adm.	1	9	12	21	-	-	-	-	-	-	-	-
Total	151	3,127	313	3,440	64	1,520	97	1,617	42.4%	48.6%	31.0%	47.0%

(Data Source: combined data from BoFED and FSCDPO, 2008)

2.4 Federal Government Plans Related to the Study

(1) Plan for Accelerated and Sustained Development to End Poverty (PASDEP)

Plan for Accelerated and Sustained Development to End Poverty (PASDEP), the second PRSP, is a national development plan for 2006-2010 which defines the nation's overall strategy for development with the ultimate objective of eradicating poverty. It is considered as a national plan for guiding all development activities during the five years and a nationally agreed development plan belonging to all Ethiopians, developed through a process of consultation among all elements of society. The required cost by sector was estimated as shown below.

Table 2.4.1 Projected PASDEP Program Cost Requirements Based on the MDGs Needs Assessment

(In Million Birr)

Sector	2005/06	2006/07	2007/08	2008/09	2009/10	Total
Agriculture & rural development and Food security	5,017	3,784	3,506	3,953	5,798	22,058
Irrigation	2,150	3,785	3,507	5,031	6,282	20,755
Education	8,236	9,372	11,612	12,620	11,902	53,742
Health	4,725	5,677	6,872	8,133	9,473	34,880
Water & sanitation	3,816	4,174	4,015	1,768	1,815	15,590
Roads	5,126	6,307	9,533	10,907	11,287	43,160
Power	9,728	11,964	9,941	11,319	7,670	50,622
HIV/AIDS	578	881	1,214	1,526	2,001	6,200
Population & development	99	666	193	240	115	1,313
Private Sector development	2,737	2,737	3,293	3,293	3,293	15,353
Urban housing development	4,850	4,850	5,834	5,834	9,334	30,702
Gender & development	161	130	120	112	118	641
Telecommunication	4,680	5,841	8,566	9,649	8,814	37,550
Grand Total	51,903	60,168	68,207	74,385	77,902	332,566

(Data source: PASDEP Volume I Main Text, p204)

The PASDEP adopts growth driven by the private sector and diversification and commercialization of small farms, and it is broadly consistent with its predecessor, the Sustainable Development and Poverty Reduction Program (SDPRP) for 2003-2005. The SDPRP laid the foundation for growth by investing in the enabling environment reforms, capacity building and decentralization. While continuing to consolidate these processes, the PASDEP has embarked on new strategic directions that can accelerate economic growth. It has eight pillars:

- A massive push to accelerate growth;
- Promoting geographically differentiated development strategy;
- Controlling population growth;
- Unleashing the potentials of Ethiopia's women;
- Strengthening the infrastructure backbone of the country;
- Managing risk and volatility;
- Massive push to reach the MDGs, and
- Creating employment opportunities.

Basically, the PASDEP pursues pro-poor growth with a major emphasis on agriculture and promotion of rainwater harvesting and irrigation, and enhancing the productivity of land and labor are mentioned as key interventions. It contains eight major elements: (i) commercialization of agriculture and promoting rapid non-farm private sector growth; (ii) geographical differentiation; (iii) population; (iv) gender; (v) infrastructure; (vi) risk management and vulnerability; (vii) scaling up service delivery; and (viii) employment. Accelerated growth is the core of the PASDEP and it sets a target to maintain 7.3% annual growth to accomplish the Millennium Development Goals.

(2) Growth and Transformation Plan (GTP)

The draft Growth and Transformation Plan (GTP), a successor of the PASDEP for the five year (2010/11-2014/15), was issued in September 2010. It contains the following four objectives.

- Maintain at least an average real GDP growth rate of 11% and meet the Millennium Development goals.
- Expand and ensure the qualities of education and health services thereby achieving the MDGs in the social sectors.
- Establish favorable conditions for sustainable state building through the creation of stable democratic and developmental state.
- Ensure growth sustainability by realizing all the above objectives within stable macroeconomic framework.

It also defines the seven pillar strategies to attain the above objectives.

- Sustaining faster and equitable economic growth
- Maintaining agriculture as a major source of economic growth
- Creating favorable conditions for the industry to play key role in the economy

- Enhancing expansion and quality of infrastructure development
- Enhancing expansion and quality of social development
- Building capacity and deepen good governance
- Promote women and youth empowerment and equitable benefit

According to the GTP, it is projected that the real GDP of Ethiopia will grow at an average annual rate of 11.2% (agriculture sector: 8.1%, industry sector: 20%, service sector: 11%). The major targets of the GTP are as follows.

Table 2.4.2 Some of the GTP Targets

Sector/Indicator	Baseline 2009/10	Plan Target 2014/15
The Macro Economy		
Real GDP growth rate (%)	11	11.2
Per Capita GDP at Current Market Prices(USD)	401	698
Total poverty-oriented expenditure as % of GDP	12.5	15.7
Capital Expenditure as % of GDP	10.0	13.0
Poverty & Welfare		
Total poverty Head Count (%)	29.2	22.2
Food Poverty Head Count (%)	28.2	21.2
Agriculture and allied activities	6.4	7.3
Agriculture value added (in billion Birr)	58.4	86.2
Number of extension service beneficiaries (thousands)	5,090	14,640
Coffee export (Ton)	319,647	600,970
Meat Export (000 Metric Ton)	10	111
Number of household participating productive Safety net program (million)	7.8	1.3
Graduates from Safety net program	730	-

(3) Rural Development Policy and Strategy

The Rural Development Policy and Strategy issued in 2002 still remains a key policy for rural development in Ethiopia. It advocates a free market economy and extrication of the nation from dependence on food aid. It also states that rapid and sustainable economic development would be ensured through agriculture-led and rural-centered development. Trade and industry will grow faster in alliance with agriculture. Agriculture accelerates trade and industry development by supplying raw materials, creating opportunities for capital accumulation and enhancing domestic markets.

Agricultural Development Led Industrialization (ADLI), which is one of the important strategies under the SARDEP, is a continuous and fundamental component from the SDPRP. It intends export growth through production of high value agricultural products and aims to have economic development by a thrust of an agricultural sector. It also aims (i) change from subsistence farming to commercial farming through cultivation of high value export crops, and (ii) land productivity improvement by application of fertilizer and improved seeds and through labor intensive farming. The target growth rates are indicated below.

Table 2.4.3 Development Targets of Agricultural Sector

	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
Annual growth in agricultural GDP (%)	12.0	10.7	9.6	8.6	7.7	6.9
Agricultural exports (US$ millions)	546.14	735.62	899.99	1,055.78	1,240.40	1,514.98

(Data Source: PASDEP Volume 2 Policy Matrix)

(4) Food Security Strategy

The Federal Food Security Strategy (The Federal Democratic Republic of Ethiopia, March 2002) rests on three pillars, which are: (1) Increase supply or availability of food; (2) Improve access/entitlement to food; and (3) Strengthening emergency response capabilities.

The focus on domestic production was largely in reliable rainfall areas, whereas the food access pillar was focused on food insecure areas. Here a range of interventions was envisaged including soil and water management, introduction of drought and pest resistance crops, income diversification (including off-farm income generation activities) and a move towards cash income for households needing some form of transfer.

The strategy contains four essential elements as shown below.

- Agricultural Production, Marketing and Credit
- Pastoral Areas
- Micro and Small Scale Enterprises
- Agricultural Exports and Diversification

There are also additional entitlement/access and targeted programs, which includes;

- Supplementary Employment and Income Schemes,
- Targeted Programs and
- Nutrition and Health Interventions.

In addition, the following three points are addressed in the Food Security Strategy.

- Emergency Capabilities
- Institutional Strengthening, Networking and Capacity Building
- Food Security Assistance

Under this policy, Food Security Coordination & Disaster Prevention Office (FSCPO) was established in the federal and regional administrations. The organizational structure for food security program in ANRS has four levels as shown in the next page. There are two processes under the Regional FSCDPO. The Food Security Process which coordinates overall food security program has 17 staff. The vision and mission of the Regional FSCDPO are below.

Vision:

See food secured, prosperous strengthened resilience to disaster and economically active community in the Amhara National Regional State.

Mission:

Assess the root causes and problems of food insecurity and make response through involving the community in various development programs/projects and coordinate different partners, to strengthen resilience to disaster, to ensure sustainable food security, and end poverty in the region.

In each zone, Zone FSCDPO is set up at its own office with 6 staff. Also at the Woreda level, there are 6 officers for the food security program but they normally station in a room of the WAO since there is more staff under the BoARD.

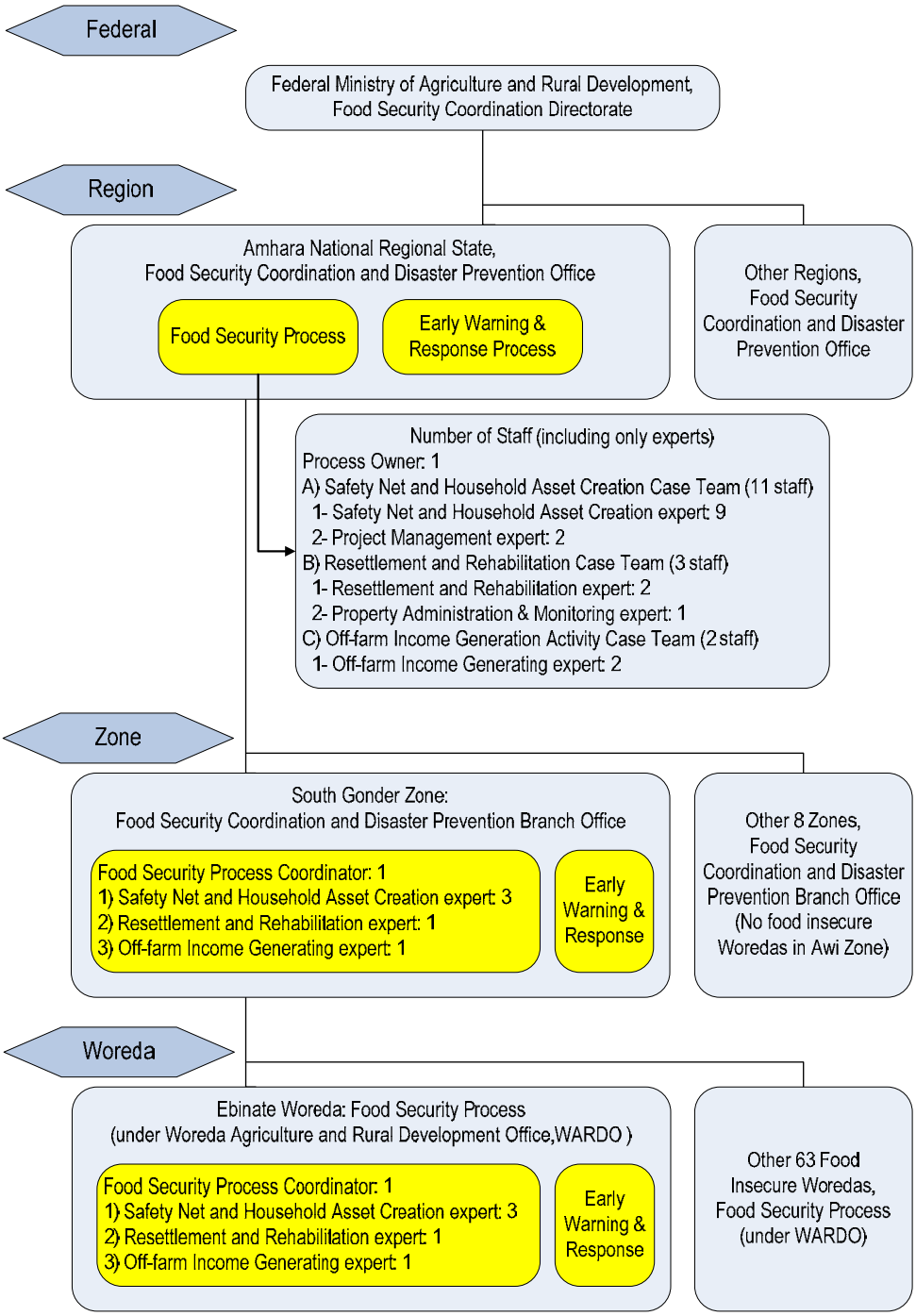


Figure 2.4.1 Organizational Structure for Food Security Program (Amhara Region)

CHAPTER 3 PRESENT SITUATION OF THE 64 FOOD INSECURE WOREDAS

3.1 Natural Environment

3.1.1 Topography, Geology and Soil

(1) Topography

The 64 Food Insecure Woredas are located in eastern side of ANRS covering the area of about 72,000 km^2, which accounts for 42.3 % of the total area of ANRS. There are 8 Woredas that have special Administration such as Dessie Town Administration, Weldia Town Administration etc. The total area of the Administrations is 839 km^2; hence the average area is only 105 km^2. The largest in the 64 Woredas is Ebinate of 2,498 km^2 and the smallest is Aregoba Special of 309 km^2.

The elevation of the 64 Woredas ranges from 572 m above sea level at Artuma Fursi Woreda, to 4,520 m at Ras Dashen in Janamora Woreda. According to the Ethiopian traditional agro-climatic zones, the areas in 64 Woredas are classified into 5 zones as shown the table below. Most areas are classified into Weyna Dega and Dega zones, which accounts for 48.3 % and 30.6 % of the total area respectively. Kolla is the third dominant zone, which locates in the east side of the area near Great Lift Valley.

Table 3.1.1 Area Distribution of the 64 Woredas by Elevation and Agro-climatic Zone

Agro-climatic Name	Elevation a.s.l. (m)	Percentage (%)
High Wurch	3,700 –	0.8
Wurch	3,200 – 3,700	4.9
Dega	2,300 – 3,200	30.6
Weyna Dega	1,500 – 2,300	48.3
Kolla	500 – 1,500	15.4
Total	–	100.0

(Source: Data processed from NASA/USGS, Bureau of Agriculture and Rural Development)

The general condition on slope in the Study Area is summarized in the table below according to the categorization of land slope condition for cultivation purpose by MoA[1]. In general the lands in the Study Areas are mostly inclined. The most dominant slope type is “Moderately Steep” of 33.0 %, followed by “Sloping” of 26.4 % and “Gently Sloping” of 21.4 %. Only 13.4 % of the area is categorized as “Flat or Almost Flat”.

Table 3.1.2 Area Distribution of the 64 Woredas by Land Slope Condition

Slope Type by Criteria	Slope (%)	Percentage (%)
Very Steep	> 50	0.2
Steep	30 – 50	5.6
Moderately Steep	15 – 30	33.0
Sloping	8 – 15	26.4
Gently Sloping	3 – 8	21.4
Flat or Almost Flat	0 – 3	13.4
Total		100.0

(Source: Data processed from NASA/USGS, Bureau of Agriculture and Rural Development)

[1] Soil and Water Conservation Manual / Guideline for Ethiopia, Ministry of Agriculture, 2001

(2) Geology

The most dominant geological formation in the 64 Woredas is Tertiary volcanic rock such as Ashangi formation, Aiba formation and Aljae formation. Quaternary sedimentary rock is distributed in some specific areas near the lakes or in the basin-shaped valleys.

Table 3.1.3 Dominant Geological Formation in the 64 Woredas

Category	Formation (Geologic Symbol)	Example of Dominant Area
Quaternary sedimentary rock	Quaternary sediments (Q, Qh)	Kobo Town, Libo Kemkem (west)
Tertiary volcanic formation	Tarmaber Gussa formation (PNtb)	Simada (north), Ebinate (west)
	Alajae formation (PNa)	Wadela, Delanta
	Aiba basalts (P_3a)	Ebinate (east), East Belesa
	Ashangi formation (P_2a)	Mekedela, Kobo

(Source: Ethiopian Institute of Geological Survey)

1) Quaternary sediments (Q, Qh)

The Quaternary sediments can be observed in the plane area such as Kobo Town Administration and the western part of Libo Kemkem Woreda. The origin of this formation is considered to be fluvial and lacustrine sediments, mostly weathered basaltic materials of Tertiary volcanic formation. Potential for agricultural activities is higher than other places due to its flat slope condition and adequate ground water potential in these areas.

2) Tarmaber Gussa formation (PNtb)

The Tarmaber formation represents Oligocene to Miocene basaltic shield volcanism[2] and it can be observed around the peak of Mt. Guna, its surrounded areas and northeast of the Lake Tana. Huge outcrops of volcanic cones can be seen on the way from Wareta to Ebinate Woredas, and this basaltic formation has an alkaline affinity, so it has some advantages for agricultural activities.

3) Alajae formation (PNa)

The Alajae formation mainly consists of aphyric flood basalts associated with rhyolites and subordinate trachytes. The Alajae formation rests conformably on the Aiba basalts and such stratigraphic strata can be seen in the peneplain of the Study Area such as Wadela and Delanta Woredas, where the elevation above sea level is more than 3,200 m. These high land areas are considered to be suitable for cultivation of Barely.

4) Aiba basalts (P_3a)

The Aiba basalts represent the second major pulse of the fissural basalt volcanism in the Region. They are generally aphyric, compact rocks, in the place showing stratification and contain rare interbedded basic tuffs. The Aiba basalts unconformably overlie the Asangi formation and attain a thickness of 200 to 600 m. The basalts show a distinctive nature in the transitions to mildly alkaline varieties. This formation can be seen at the circumference of Alajae formation in Wadela, Delanta, Ebinate and East Belesa Woredas.

[2] Explanation of the geological map of Ethiopia, second edition, scale 1: 2,000,000, Ethiopian Institute of Geological Survey, September 1996

5) Ashangi formation (P_2a)

The Ashangi formation represents the earliest fissural flood basalt volcanism in the region. The basalt flows are several hundreds meters to a kilometer in thickness of strongly weathered, crushed and tilted basalts. The Ashangi formation consists of predominantly mildly alkaline basalts with interbedded basalts pyroclastics and rare rhyolites and is commonly injected by dolerite sills and dykes. The upper part of Ashangi formation is more tuffaceous and contains interbedded lacustrine deposits with lignite seams. It can be observed in Mekedela, Mekete and Kobo Woredas.

(3) Soil

There are 12 major distinct soil types in the Study Area (Lithosols, Eutric Cambisols, Chromic Luvisols, Pellic Vertisols, Cambic Arenosols, Orthic Luvisols, Cromic Vertisols, Dystric Cambisols, Eutric Regosols, Eutric Nitosols, and Vertic Cambisols). The most dominant type is Lithosols, which consists of more than half of the 64 Woredas, followed by Eutric Cambisols of 18.4 %, Chromic Luvisols of 7.1 % and so on. Lithosols have thin soil in thickness properties.

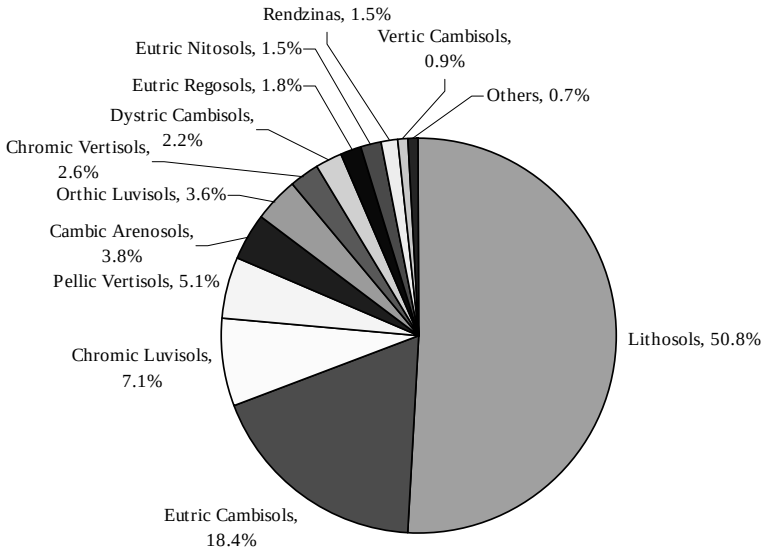


Figure 3.1.1 Proportion of Major Soil Types in the 64 Woredas

(Source: Data processed from Woody Biomass Inventory and Strategic Planning Project, 2004, MoARD)

1) Lithosols

Lithosols are mineral soils and are developed on hard rock with less than 10 cm in thickness. Usually, these soils lie at mountainous areas forming pasture land. Due to shallow depth of soils, they are not suitable for agriculture. 50.8 % of the Study Area is covered by these soils.

2) Eutric Cambisols

Eutric Cambisols have more than 50 percent of base saturation, and are originated by properties of mother rock of Basalt in the Study Area. They are normally found in sub-humid climate area with Ochric epipedon and Cambic horizon (metamorphic B horizon) with strong red-brown color. These types of soils are suitable for agriculture use if soil thickness is enough but not at hilly places. In the Study Area, these soils are found at sloping land with shallow soil thickness. Therefore, agricultural

value of these soils is considered to be low. 18.4 % of the Study Area is covered by these soils.

3) Chromic Luvisols

Chromic Luvisols are usually developed from basic rocks in sub-humid climate area in sub-tropical zone, and have an argillic B horizon and show high base saturation with 50 % or more. These soils have weatherable minerals and are considered to be suitable for agriculture. As the name "Chromic" indicates, the soils show strong dark brown or red-brown color. These cover 7.1% of the Study Area.

4) Pellic Vertisols

Pellic Vertisols are developed at plains or gentle sloping places with a climate condition of pronounced dry seasons. These soils contain more than 30% of swelling clay, and cracks in polygonal pattern are developed during dry season with more than 1 cm in width and 50cm in depth, the soils swell during rainy seasons. The soils show dark color and agricultural suitability on the soils is fairly good but limited because of their properties; sticky in rainy seasons but shrink and hard in dry season. These soils cover 5.1% of the Study Area.

In general depth of soil has been becoming shallow because of continuous erosion. As shown in the table below, in most Woredas the mean soil depth is between 10 and 50 cm. Asagirt and Goncha Siso Enese Woredas have the shallowest soil; 84.5 % and 79.1 % of the area are less than 10 cm of soil depth respectively. On the other hand, Jilena Timuga Woreda has the deepest soil; 58.4 % is between 50 and 150 cm. The annual soil loss is estimated at as much as 11.5 mm on average.

In the 64 Woredas, the high rate of soil loss causes poor vegetation on the hilly areas and accelerates surface soil erosion with the progressive and selective removal of the lighter particles and organic materials. Thus, this type of erosion leaves behind the coarser silt and sand, in turn, which makes the soil more erodible condition. Furthermore, the most sub-soils are usually heavier and inherently less permeable than top soils because of their structure and texture formation, so that run-off at ground surface increases[3].

[3] Highlands Reclamation Study, Ethiopia, Final Report volume 1, Food and Agriculture Organization of the United Nations, 1986, Rome

Table 3.1.4 Depth and Annual Loss of Soil in the 64 Woredas

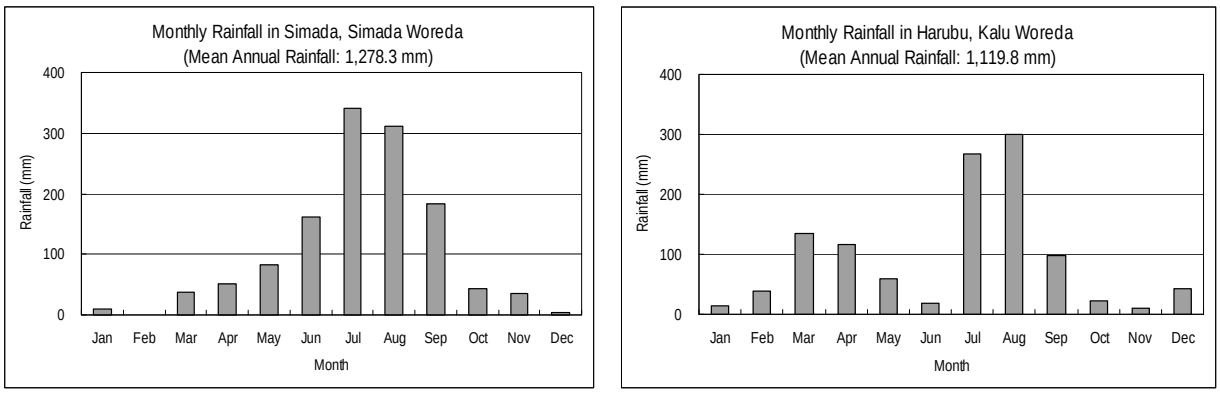
No.	Woreda	Zone	Range of Soil Depth (%)			Mean Annual Soil Loss (mm)
			< 10 cm	10-50 cm	50-150 cm	
1	Enebse Sar Mider	East Gojam	0.0	84.2	15.8	5
2	Goncha Siso Enese	East Gojam	79.1	20.9	0.0	9
3	Shebele Berenta	East Gojam	34.8	53.6	11.6	14
4	Adarekaye	North Gonder	4.3	94.2	1.5	42
5	Beyeda	North Gonder	0.0	100.0	0.0	9
6	Dabat	North Gonder	6.8	78.7	14.5	34
7	Debark	North Gonder	0.0	100.0	0.0	37
8	East Belesa	North Gonder	0.0	100.0	0.0	5
9	Janamora	North Gonder	0.0	75.6	24.4	16
10	Telemt	North Gonder	0.0	100.0	0.0	28
11	West Belesa	North Gonder	0.0	100.0	0.0	12
12	Wogera	North Gonder	0.0	94.7	5.3	12
13	Angolelana Tera	North Shewa	0.0	69.0	31.0	18
14	Asagirt	North Shewa	84.5	14.7	0.8	13
15	Gishe Rabele	North Shewa	0.0	100.0	0.0	15
16	Menze Gera Mider	North Shewa	0.0	97.1	2.9	29
17	Menze Lalo Mider	North Shewa	39.2	60.8	0.0	38
18	Menze Mama Mider	North Shewa	0.0	100.0	0.0	25
19	Menze Qeya Gebriel	North Shewa	0.0	100.0	0.0	47
20	Bugena	North Wello	0.0	100.0	0.0	1
21	Dawunt	North Wello	0.0	100.0	0.0	4
22	Delanta	North Wello	0.0	100.0	0.0	4
23	Gidan	North Wello	0.0	77.3	22.7	4
24	Guba Lafto	North Wello	0.0	60.7	39.3	5
25	Habru	North Wello	0.0	100.0	0.0	3
26	Kobo	North Wello	0.0	100.0	0.0	5
27	Lasta	North Wello	0.0	74.9	25.1	4
28	Mekete	North Wello	0.0	100.0	0.0	5
29	Wadela	North Wello	0.0	100.0	0.0	3
30	Artuma Fursi	Oromiya	0.0	100.0	0.0	7
31	Bati	Oromiya	0.0	100.0	0.0	5
32	Dewa Chefa	Oromiya	0.0	96.8	3.2	9
33	Dewa Harewa	Oromiya	0.0	100.0	0.0	2
34	Jilena Timuga	Oromiya	0.0	41.6	58.4	5
35	Ebinate	South Gonder	0.0	100.0	0.0	4
36	Laye Gayint	South Gonder	0.0	100.0	0.0	12
37	Libo Kemkem	South Gonder	0.0	95.2	4.8	11
38	Simada	South Gonder	0.0	93.5	6.5	4
39	Tach Gayint	South Gonder	0.0	100.0	0.0	6
40	Alebuko	South Wello	0.0	100.0	0.0	11
41	Ambassel	South Wello	0.0	93.4	6.6	10
42	Aregoba Special	South Wello	0.0	74.4	25.6	7
43	Debre Sina	South Wello	0.0	100.0	0.0	4
44	Dessie Zuria	South Wello	0.0	97.3	2.7	10
45	Jamma	South Wello	0.0	100.0	0.0	30
46	Kalu	South Wello	0.0	100.0	0.0	10
47	Kelela	South Wello	0.0	100.0	0.0	14
48	Kuta Ber	South Wello	0.0	97.6	2.4	12
49	Legambo	South Wello	0.0	96.7	3.3	10
50	Legehida	South Wello	0.0	100.0	0.0	14
51	Mehal Sayint	South Wello	0.0	86.9	13.1	3
52	Mekedela	South Wello	0.0	86.0	14.0	9
53	Sayint	South Wello	0.0	97.7	2.3	5
54	Tehulederie	South Wello	0.0	70.1	29.9	7
55	Tenta	South Wello	0.4	77.6	22.0	10
56	Wogedi	South Wello	0.0	100.0	0.0	15
57	Wore Illu	South Wello	0.0	100.0	0.0	17
58	Worebabu	South Wello	0.0	100.0	0.0	7
59	Abergelie	Wag Himera	0.6	61.5	37.9	5
60	Dahena	Wag Himera	0.0	100.0	0.0	2
61	Gazgibela	Wag Himera	0.0	94.5	5.5	3
62	Sehala	Wag Himera	0.0	93.4	6.6	3
63	Seqota	Wag Himera	0.0	100.0	0.0	2
64	Zequala	Wag Himera	0.0	100.0	0.0	2
Average			3.9	89.2	6.9	11.5

(Source: Data processed from Highland Reclamation Study Ethiopia (1986), FAO)

3.1.2 Meteorology and Hydrology

(1) Rainfall

The Study Area is divided into two rainfall patterns with two and three seasons. The western half of the Study area has two distinct seasons; wet from June to September and dry from November-February, with the rainfall peak occurring from July to August. On the other hand, the eastern half has two rainy periods and one dry period; the main "Kiremt" rain from June to September, small "Belg" rains form March to May, and dry "Bega" from October to February. (See "1.1 Rainfall" in Appendix B for details.)



An Example of Two Seasons　　An Example of Three Seasons

Figure 3.1.2 Examples of Monthly Rainfall in the 64 Woredas

(Source: Processed from Data of National Meteorological Agency)

Major influences for the climate in the Study Area are given by the Inter-Tropical Convergence Zone (ITCZ), the northeast trade winds and the southeast monsoon[4]. After dry season, the ITCZ is located at southern side of the Study Area. Then, high pressure cell in South West Asia (Indian Ocean) becomes weak so the effect of the northeast trade winds becomes insignificant. Easterly and south-easterly trade winds blow from the high pressure areas over the Gulf of Aden and the Indian Ocean, which bring moisture-laden air masses during the period from March to May.

After that, the ITCZ lies in the north and northeast of the Study Area around the Gulf of Aden and the Red Sea. Besides, it is identified that the high pressure cells develop in the Atlantic Ocean. The Guinea Monsoon winds from the Atlantic Ocean (the Gulf of Guinea) bring warm and moist airs to a central part of the African Continent in which low pressure cells exist. The warm and moist airs are forced to go up due to mountains of the Continent, and they become thereby cool and lose moisture holding capacity[4]. As a result, most of the Study Areas receive precipitations from June to September.

(2) Temperature

There is a variety of climatic zones in the 64 Woredas. Most part of the area is under subtropical and temperate zones, and the remaining are tropic or boreal zones. The temperature in the area is mainly related with altitude as shown in the table below. In Kolla zone, generally annual mean temperature is

[4] Highlands Reclamation Study, Ethiopia, Final Report volume 1, Food and Agriculture Organization of the United Nations, 1986, Rome

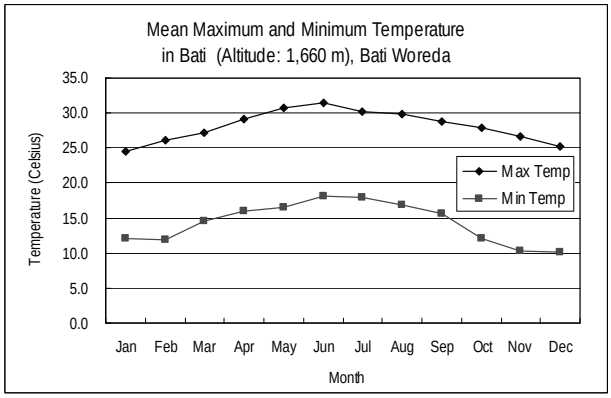
more than 25 °C, which corresponds to tropic zone. On the other hand, Weyna Dega and Dega zones, which account for 78.9 % the Study Area, correspond to sub-tropic and temperate zones respectively, and Wurch and High Wurch zones to boreal zone. Thus, the Study Area has a considerably wide range of temperature differences mainly due to its variations in elevation. (See "1.2 Temperature" in Appendix B for details.)

Table 3.1.5 Relationship of Traditional Agro-climate Zone and Mean Temperature[5]

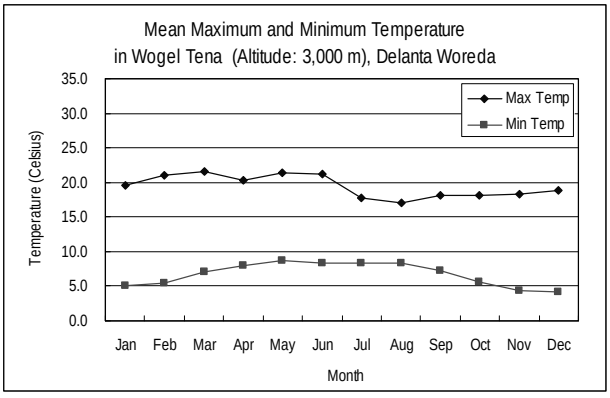
Agro-climatic Zone	Elevation (m a.s.l.)	Dry condition P < 900mm	Moist Condition 900 <= P <=1,400mm	Wet Condition P > 1,400mm
High Wurch	3,700 –			< 10 C°
Wurch	3,200 – 3,700		7 – 12 C°	7 – 12 C°
Dega	2,300 – 3,200		12 – 18 C°	12 – 18 C°
Weyna Dega	1,500 – 2,300	18 – 25 C°	18 – 25 C°	18 – 25 C°
Kolla	500 – 1,500	> 25 C°	> 25 C°	

(Source: Bureau of Agriculture and Rural Development, ANRS)

The following figures are examples of monthly maximum and minimum temperature in the 64 Woredas. In Bati Meteorological Station, which is located at 1,660 m a.s.l. in Bati Woreda, the mean maximum and minimum temperatures are as much as 28.4 °C and 14.7 °C respectively. In Wogel Tena Station at 3,000 m in Delanta Woreda, on the other hand, the temperatures are only 19.5 °C and 7.0 °C.



An Example of Sub-tropic Zone



An Example of Temperate Zone

Figure 3.1.3 Examples of Monthly Temperature in the 64 Woredas

(Source: Processed from Data of National Meteorological Agency)

3.1.3 Water Resources

(1) Water Basin

There are four water basins in the Study Area, namely, Takeze, Blue Nile (Abay), Awash and Afar Interior. The Takeze water basin includes 22 Woredas in the northern par t of the Study Area including most part of Ebinate, Bugena and Gidan Woderas. The most part of Wereta - Weldia trunk road composes the southern edge of this water basin. The Blue Nile water basin largely occupies the southern part of the Study Area and consists of 30 Woredas including Simada, Mekedela and Legambo Woredas. The Wereta -Weldia trunk road is the northern border of the basin edge, and Debre Sina - Dessie trunk road is the eastern edge of this water basin. The Awash water basin is located at

[5] Soil and Water Conservation Manual / Guideline for Ethiopia, Ministry of Agriculture, 2001

southeastern side of the Study Area, and consists of 11 Woredas including Aregoba Special Woreda. Debre Sina -Dessie trunk road is the western boundary of this water basin, and the northern edge is Weldia. The remaining northeastern parts of the Study Area are on the Afar interior water basin which includes only Kobo and a part of Guba Lafto Woredas.

(2) Potential of Water Resources

Water resources in the Study Area are composed of three (3) major types; surface water by precipitation, base flow and ground water.

1) Surface Water

The surface water is available mostly in rainy season but its availability in amount and duration are relatively limited. It is well known as unpredictable and uncertain water resource. Due to shallow surface soil and few organic materials in it, the total of water retention capacity of the soil in the hilly areas is low. Water from precipitation saturates pores of surface soils and it runs off quickly from the high land area to low land through rivers, while carrying fine soil particles. Thus, about 50 - 80 percent of annual soil losses occur during the five most intense storms in a year[6], as percolation speed into the surface soils becomes low within certain time after soil pore saturation by rain water.

2) Base Flow

In contrast to the surface water, the base flow water runs off slowly in long duration with relatively large amount. This is because it comes from aquifers of ground water through cracks of rock foundations. It can be observed in the form of spring or weeping water from the rock foundation, and the water from the springs and weeping confluents. Then it forms the river stream. Although this base flow is usually one of the most reliable natural water resources for human, it is very difficult to develop artificially. Some of these water resources are already utilized in rural areas for irrigation and/or domestic purposes. It can be considered that the base flow has high potential for water resource development in the Study Area, however, the development have to be done with protection measures of watersheds and water basins in order to prolong its life period.

3) Ground Water

Basalt is the dominant foundation of rock in the Study Area. It is considered that aquifer in the basalt is not so developed and the available location of the ground water is quite limited. The ground water resource development is considered to be the particular case in the Study Area but it can produce reliable quantity of water throughout the year. Whilst a pumping up system is usually used for the water resource development, only commercial farming or public water supply project are feasible to the installation, management and operation cost. In case of commercial farming, logistic condition is one of the most important factors for its feasibility. From these aspects, ground water development for commercial farming is considered not so typical scheme in the Study Area but it makes high profitability if the location is selected appropriately.

[6] Highlands Reclamation Study, Ethiopia, Final Report volume 1, Food and Agriculture Organization of the United Nations, 1986, Rome

Taking into account the aspects mentioned above, the base flow water is the most accessible water resource in the Study Area. Although potential water volume is figured out by water balance simulation by utilizing data from 2004 to 2006 as follows, due to inadequate information from the concerned organizations, validation and checking have not yet been carried out.

As shown in the table below, potential irrigable area, calculated by utilizing a half of average base flow, ranges from 7.2 ha to 21.4 ha in 1 km^2, if 1,000 mm of irrigation is carried out. Average yield of Wheat is about 2 tons/ha and that of Teff is about 1 ton/ha. Cereal requirement per capita per annum in Ethiopia[7] is 225Kg, which implies that irrigated Teff farming by base flow water can support 64 - 95 persons or 124 - 190 persons by Wheat farming per km^2. However, this kind of estimation is actually impractical proposition, as the locations of farmland and water resources must be near and elevation of water resource must be higher than farmland in the case of gravity irrigation system. Thus, while there is potential of water resource existence, its availability requires further studies.

Table 3.1.6 Potential Base Flow Water Quantity at Each Water Basin in the 64 Woredas

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Water Basin Name	Average annual Precipitation ('04 – '06)	Average of Minimum Base Flow ('04 – '06)	Average of Base Flow ('04 – '06)	= (3) / (4) (%)	Presumed potential = (5)/2 (%)	Irrigable area per km^2 using 1,000mm
Takeze	1,031.5 mm	421.1 mm	471.5 mm	89.3	45	21.2 ha
Blue Nile	1,038.6 mm	278.9 mm	359.5 mm	77.4	40	14.4 ha
Awash	741.4 mm	144.7 mm	288.4 mm	50.2	25	7.2 ha
Afar Interior	945.6 mm	253.5 mm	377.9 mm	67.1	35	13.2 ha

Note; (7) "Irrigable area per km^2 using 1,000mm" is calculated by following equation.
(7) = (4) X (6)/100 X / (1,000mm / m) X (1,000m X 1,000m) / 1m / (100m X 100m / ha)
(Source: Processed from Data of National Meteorological Agency)

(3) Domestic Water Sources

As shown in the table below, the most common water source for domestic use is unprotected spring, which accounts for 44.5% in dry Bega and 39.2% in main Kiremt rainy seasons. The other sources are developed spring and river. However, this tendency differs according to the areas and the seasons. In some Woredas, for example, developed spring or river is used as the primary source of the domestic water. (See Table 2.1 in Appendix B for details.)

Table 3.1.7 Domestic Water Sources in the 64 Woredas

Water Sources (%)									
Unprotected Spring		River		Developed Spring		Tap Water		Other	
Bega	Kiremt	Bega	Kiremt	Bega	Kiremt	Bega	Kiremt	Bega	Kiremt
44.5	39.2	16.7	19.2	16.8	16.1	7.0	7.3	15.0	18.2

Source: Data processed from
1. Rural Households Socio-economic Baseline Survey of 56 Woredas in Amhara Region Vol. XV Water Resources (2003), ANRS Bureau of Rural Development
2. Rural Households Socio-economic Baseline Survey of 50 Woredas in Amhara Region (Phase II) Vol. XV Water Resources (2004), ANRS BoFED)

(4) Potable Water Source

The most common source of potable water is developed spring, which accounts for 57.2% in dry Bega

[7] Rural household socio-economic base line survey of 56 Woredas in the Amhara Region, Volume IX Food Security, Bureau of Rural Development, Bahir Dar, ANRS, April 2003

and 55.7% in main Kiremt rainy seasons, followed by tap water for 23.3% and 24.9%. As well as domestic water, this tendency differs according to the availability of them. In some Woredas such as Ebinate and Shebele Berenta Woredas, for example, Tap Water is identified as the most common potable water source. (See Table 2.2 in Appendix B for details.)

Table 3.1.8 Potable Water Sources in the 64 Woredas

Water Sources (%)							
Developed Spring		Tap Water		Hand Dug Well		Borehole	
Bega	Kiremt	Bega	Kiremt	Bega	Kiremt	Bega	Kiremt
57.2	55.7	23.3	24.9	9.9	10.7	9.6	8.7

Source: Data Processed from
1. Rural Households Socio-economic Baseline Survey of 56 Woredas in Amhara Region Vol. XV Water Resources (2003), ANRS Bureau of Rural Development
2. Rural Households Socio-economic Baseline Survey of 50 Woredas in Amhara Region (Phase II) Vol. XV Water Resources (2004), ANRS BoFED)

3.1.4 Forest Resources

(1) Vegetation Type

The most dominant vegetation type of the 64 Woredas is cropland, which accounts for 65.1 % of the total. Woody vegetation, which includes evergreen, deciduous and open forests and shrub, accounts for only 15.2 % while grassy vegetation for 19.3 %. According to Climax Vegetation Ethiopia (Ethiopian Mapping Authority, 1989), however, major climax vegetations in the Study Area are forests that are dominated by *Juniperus procera* (Tid), *Olea africana* (Weira), *Podocarpus falcatus* (Zigba), *Arundinaria alpina* (Kerkha) etc. It implies that the present vegetation, which is mostly covered with cropland and grassland, have been formed by high pressure of deforestation.

(2) Ownership

Currently there are three major forest ownership types in the Region, that is, State, Community and Private forests. The present status of these forests is as follows[8].

1) State Forest

State forest is categorized into five types such as Natural Forest, Woodland, Bamboo and Reed Thicket, Riparian Forest and Plantation.

Natural Forest

The natural forest refers to scattered patches of tree species such as *Juniperus procers, Olea africana, Podocarpus falcatus* and other broad leaved trees. At present the estimated total area of natural forests in the Study Area is only 8,280 ha and grouped into five Regional Forest Priority Areas (RFPAs).

Woodland

The Woodlands, bushlands and shrublands in the Region includes a variety of woody vegetation types. They cover in total 5,281,407 ha in the Region

[8] ANRS Forestry Action Program Vol. I Main Report, ANRS Bureau of Agriculture, 1999

Table 3.1.9 Distribution of Vegetation Types in the 64 Woredas

No.	Woreda	Zone	Vegetation Type in Woreda (%)										Total Area (km^2)
			Evergreen Forest	Deciduous Forest	Open Forest	Shrub	Grass (Single Layer)	Grass with Sparse Tree/Shrub	Cropland	Rock	Sand	Water	
1	Enebse Sar Mider	East Gojam	0.0	0.0	4.1	0.0	7.7	1.7	86.3	0.0	0.0	0.3	1,065
2	Goncha Siso Enese	East Gojam	0.0	0.0	24.8	0.1	1.6	3.1	70.3	0.0	0.0	0.0	1,018
3	Shebele Berenta	East Gojam	0.2	0.2	19.2	0.5	6.9	0.5	72.3	0.0	0.0	0.0	897
4	Adarekaye	North Gonder	1.6	0.0	73.1	0.0	0.0	6.8	19.4	0.0	0.0	0.0	1,503
5	Beyeda	North Gonder	0.0	0.0	4.9	1.2	11.3	17.9	64.5	0.0	0.0	0.0	875
6	Dabat	North Gonder	0.0	0.0	52.7	0.0	2.2	0.5	44.9	0.0	0.0	0.0	1,223
7	Debark	North Gonder	0.2	0.1	50.6	0.2	2.8	2.1	44.2	0.0	0.0	0.0	1,479
8	East Belesa	North Gonder	0.0	0.0	2.6	0.0	3.4	0.3	93.8	0.0	0.0	0.0	1,817
9	Janamora	North Gonder	0.0	0.0	4.6	0.1	6.7	5.5	83.4	0.0	0.0	0.0	1,950
10	Telemt	North Gonder	0.1	0.0	6.1	0.0	27.8	8.2	58.3	0.0	0.0	0.0	1,256
11	West Belesa	North Gonder	0.0	0.0	15.0	0.0	5.9	0.3	78.8	0.0	0.0	0.0	1,169
12	Wogera	North Gonder	0.1	0.0	22.4	0.0	1.9	1.3	74.7	0.0	0.0	0.0	1,821
13	Angolelana Tera	North Shewa	0.0	0.0	45.7	0.0	0.1	2.0	52.0	0.0	0.0	0.0	803
14	Asagirt	North Shewa	0.0	0.0	39.7	0.0	0.0	37.5	23.1	0.0	0.0	0.0	522
15	Gishe Rabele	North Shewa	0.4	0.0	19.5	0.0	16.7	1.9	60.6	0.0	0.0	0.0	626
16	Menze Gera Mider	North Shewa	0.0	0.0	15.8	0.0	9.4	10.8	63.6	0.0	0.0	0.0	1,106
17	Menze Lalo Mider	North Shewa	0.5	0.0	27.1	0.0	13.6	6.9	51.4	0.0	0.0	0.0	364
18	Menze Mama Mider	North Shewa	0.1	0.0	27.5	0.0	7.0	10.1	55.1	0.0	0.0	0.0	666
19	Menze Qeya	North Shewa	0.1	0.0	27.8	0.0	9.1	2.6	59.8	0.0	0.0	0.0	589
20	Bugena	North Wello	0.0	0.0	11.3	0.0	1.0	2.2	85.2	0.0	0.0	0.0	1,146
21	Dawunt	North Wello	0.0	0.0	2.4	0.0	5.3	1.4	90.7	0.0	0.0	0.0	621
22	Delanta	North Wello	0.0	0.0	4.8	0.0	5.3	7.1	82.3	0.0	0.0	0.0	1,053
23	Gidan	North Wello	0.0	0.0	16.1	0.1	10.8	19.9	52.9	0.0	0.0	0.0	1,046
24	Guba Lafto	North Wello	0.4	0.0	7.1	0.1	6.3	44.0	41.9	0.0	0.0	0.0	930
25	Habru	North Wello	0.1	0.0	15.8	0.2	7.5	61.4	14.4	0.0	0.0	0.0	1,672
26	Kobo	North Wello	0.0	0.0	1.6	0.1	5.8	64.1	27.0	0.0	0.0	0.0	1,734
27	Lasta	North Wello	0.1	0.0	10.1	0.1	12.2	8.1	68.9	0.0	0.0	0.0	1,155
28	Mekete	North Wello	0.0	0.0	6.7	0.0	5.4	1.3	86.4	0.0	0.0	0.0	1,935
29	Wadela	North Wello	0.0	0.0	2.3	0.0	6.8	4.2	87.4	0.0	0.0	0.0	819
30	Artuma Fursi	Oromiya	0.0	0.2	34.1	0.5	9.2	38.7	14.1	0.6	2.0	0.0	1,085
31	Bati	Oromiya	0.0	0.0	10.8	0.0	4.6	58.4	25.2	0.0	0.0	0.0	1,100
32	Dewa Chefa	Oromiya	0.3	0.0	71.8	0.0	0.0	23.1	4.7	0.0	0.0	0.0	569
33	Dewa Harewa	Oromiya	0.0	0.0	59.3	0.0	0.0	30.4	10.2	0.0	0.0	0.0	502
34	Jilena Timuga	Oromiya	0.0	0.0	33.8	0.0	0.2	23.4	42.3	0.0	0.0	0.0	884
35	Ebinate	South Gonder	0.0	0.0	13.5	0.0	0.6	0.5	85.5	0.0	0.0	0.0	2,499
36	Laye Gayint	South Gonder	0.0	0.0	13.2	0.0	2.3	1.1	83.4	0.0	0.0	0.0	1,549
37	Libo Kemkem	South Gonder	0.0	0.0	11.6	0.0	8.9	1.3	78.3	0.0	0.0	0.0	952
38	Simada	South Gonder	0.0	0.0	6.5	0.1	9.1	0.5	83.6	0.0	0.0	0.0	2,260
39	Tach Gayint	South Gonder	0.0	0.0	0.7	0.0	4.0	0.3	95.1	0.0	0.0	0.0	825
40	Alebuko	South Wello	0.0	0.0	13.2	0.0	10.2	17.9	58.6	0.0	0.0	0.0	492
41	Ambassel	South Wello	0.6	0.0	16.3	0.0	7.5	22.3	53.0	0.0	0.0	0.0	906
42	Aregoba Special	South Wello	0.0	0.0	63.5	0.0	0.0	11.5	24.9	0.0	0.0	0.0	309
43	Debre Sina	South Wello	1.1	0.0	12.8	0.0	7.0	6.4	72.5	0.0	0.0	0.0	1,001
44	Dessie Zuria	South Wello	0.0	0.0	6.2	0.0	4.4	20.8	68.8	0.0	0.0	0.0	965
45	Jamma	South Wello	0.0	0.0	12.2	0.0	18.8	3.1	64.9	0.0	0.0	0.0	1,060
46	Kalu	South Wello	0.2	0.0	17.6	0.0	1.7	33.4	46.3	0.0	0.0	0.5	930
47	Kelela	South Wello	0.0	0.0	21.1	0.1	7.0	1.8	70.2	0.0	0.0	0.0	1,464
48	Kuta Ber	South Wello	0.0	0.0	7.9	0.0	4.9	13.5	72.9	0.0	0.0	0.0	724
49	Legambo	South Wello	0.2	0.0	9.2	0.0	6.9	29.8	53.9	0.0	0.0	0.0	1,001
50	Legehida	South Wello	0.0	0.0	8.3	0.0	13.3	8.8	69.6	0.0	0.0	0.0	522
51	Mehal Sayint	South Wello	0.0	0.0	1.0	0.1	8.2	7.9	82.3	0.0	0.0	0.0	592
52	Mekedela	South Wello	0.0	0.0	0.8	0.1	3.5	5.7	89.6	0.0	0.0	0.0	1,469
53	Sayint	South Wello	0.0	0.0	5.2	0.0	1.5	15.5	77.4	0.0	0.0	0.0	1,470
54	Tehulederie	South Wello	0.0	0.0	23.6	0.0	0.6	50.5	19.5	0.0	0.0	5.0	470
55	Tenta	South Wello	0.0	0.0	9.1	0.1	3.6	11.9	74.9	0.0	0.0	0.0	1,337
56	Wogedi	South Wello	0.0	0.0	16.2	0.0	6.1	1.3	76.3	0.0	0.0	0.0	1,092
57	Wore Illu	South Wello	0.1	0.0	14.0	0.0	20.1	1.1	64.0	0.0	0.0	0.0	783
58	Worebabu	South Wello	0.0	0.0	4.8	0.0	8.2	65.8	20.6	0.0	0.0	0.3	799
59	Abergelie	Wag Himera	0.0	0.0	0.0	0.0	34.4	0.4	62.8	0.0	2.4	0.0	1,607
60	Dahena	Wag Himera	0.0	0.0	6.8	0.0	0.9	1.3	91.0	0.0	0.0	0.0	1,676
61	Gazgibela	Wag Himera	0.0	0.0	4.1	0.0	5.4	7.7	83.1	0.0	0.0	0.0	1,082
62	Sehala	Wag Himera	0.0	0.0	0.0	2.0	31.7	10.7	53.5	0.0	2.4	0.0	950
63	Seqota	Wag Himera	0.0	0.0	4.8	0.0	6.2	1.4	87.2	0.0	0.0	0.0	1,672
64	Zequala	Wag Himera	0.0	0.0	0.4	0.6	14.7	1.1	82.2	0.0	1.1	0.0	1,702
Total			0.1	0.0	15.0	0.1	7.2	12.1	65.1	0.0	0.1	0.0	71,158

(Source: Data processed from Global Map of Ethiopia (2008), International Steering Committee for Global Mapping (ISCGM))

Table 3.1.10 Regional Forest Priority Areas (RFPAs) in the 64 Woredas

Forest Areas	Woreda	Zone	Area (ha)
Guna*	Laye Gayint	South Gondar	1,054
Weyneye	Guba Lafto	North Wollo	1,200
Yegof	Dessie Zuria	South Wollo	1,526
Denkoro	Debre Sina, Sayint	South Wollo	2,300
Yerge	Dewa Chefa	Oromia	2,200
Total			8,280

*Some areas of this forest are out of the Study Area

Bamboo and Reed Thicket

In ANRS, this vegetation type is located mostly in north Gondar and Awi zones and represented by *Phuagmites communis*, *Oxythenantera abyssinica* and *Arundinaria alpina*. The total area is estimated to be 47,477 ha in the Region.

Riparian Forest

Riparian forests grow along the main rivers primarily below 1,000 m a.s.l. in the arid and semiarid areas. Important species of the forest include *Celtus krausiana*, *Ficus sycamorus*, *Mimosops kummel*, *Tamarindus indica*, *Mythanus senegalensis*, *Syzigum guinensis*, *Baphia abyssinica*, *Kegelia aethiopium*, *Cyathea maniana* and *Acacia* species. It is estimated to be 42,364 ha in the Region.

Plantation

There are about 10,114 ha of plantation forests in ANRS. At present, however, these plantations are not properly managed due to a lack of clear definition of ownership. Most plantations were established between 1977 and 1991 by WFP and the Government budget mainly for soil and water conservation.

2) Community Forest

In the Region, the total land under community forest is estimated at 66,211 ha. When community forestry schemes were established, they were to serve two broad objectives; provide fuelwood and construction materials, and rehabilitate degraded lands. Communities were given responsibility to develop, protect and utilize them.

3) Private Forest

Farmers have been involved in the cultivation of trees on agricultural lands, homesteads, roadsides and around farm plats for long time. Currently, it is estimated that there are over 70,000 ha individually owned farm forests in the Region. Though farmers are well motivated to plant trees, there is over preference of Eucalyptus and much reluctance of indigenous trees.

(3) Supply and Demand

In ANRS, the demand for forest products comes from furniture and joinery units, construction industry and households. The estimated demand for the year 1999 in the Region was 15,033,765 m^3 of fuelwood, 648,440 m^3 of construction wood and so on. The fuel wood accounts for the most amount,

95.1%, of the total demand[9]. It is because the most people use wood for their fuel consumption.

In the 64 Woredas, wood accounts for the largest amount of the primary source of fuel, on average 65.1 %, followed by dung of 19.7 %, BLT (branches, leaves and twigs) of 10.1 % and so on. However, this rate differs significantly according to the Woredas. In Goncha Siso Enese and Debre Sina Woredas, for example, wood accounts for about 95 % of the primary fuel source while in Angolelana Tera Woreda for less about 10 %. (See Table 4.1 in Appendix B for details) On average 57.4% of people collect fuelwood primarily from natural forest and 30.0% from plantation. However, these figures also differ according to the Woredas. In some Woredas such as East Belesa and Seqota, more than 90% of people depend on natural forest while in Gishe Rabele and Debre Sina less than 20 %. (See Table 4.2 in Appendix B for details.)

3.1.5 Development Potentials and Constraints

Considering the present situations of the natural environment in 64 Woredas, the following development potential and limitation are identified in the area as shown in the table below.

Table 3.1.11 Potentials and Constraints of Natural Environment

Item	Potentials	Constraints
Topography	✓ Weyna Dega zone, where climate conditions are considered to be suitable for farming, occupies nearly a half of the Study Area.	✓ Flat or Almost flat (0-3 %) and Gently Sloping (3-8 %) areas represent only one third of the Study Area.
Soil	✓ Origins of the most of soils are alkaline mother-rocks: basically it contains many and kinds of minerals.	✓ Due to steep topography, soil loss rate is high; on average: 11.5 mm/year. ✓ Due to soil erosion, soils are shallow; depth is 10 - 50 cm in most areas
Rainfall	✓ In most areas, there is comparatively large amount of annual rainfall; it is over 900 mm at 41 Woredas out of 64 Woredas.	✓ In the eastern areas the amount of annual rainfall is relatively small; it is less than 600 mm at 13 Woredas out of 64 Woredas. ✓ Most of precipitation concentrates in main Kiremt (Meher) rainy season and drought frequently occurs in small Belg rainy season.
Water Resources	✓ Base water flow has high potential for water resource development.	✓ Available volume and period of surface water are limited. ✓ Soils have low water retention capacity due to infertile and shallow surface soil. ✓ Potential sites for groundwater development are limited due to basaltic foundation rock.
Forest Resources	✓ Due to large amount of rainfall, generally potential of forest development is high.	✓ Demand for woody biomass is high even though most forests have already been devastated. ✓ Most of the lands have already been distributed to individuals, so communal land for reforestation and conservation is limited.

(1) Potentials

In most Woredas, the amount of annual rainfall is generally large. According to the record of meteorological stations in the Study Areas, for example, mean annual rainfall is more than 900 mm at 67 % of the stations. (See Table 1.1 and Table 1.2 in Appendix B for details.) Alkaline soils are

[9] ANRS Forestry Action Program Vol. I Main Report, ANRS Bureau of Agriculture, 1999

dominant and ancient Egypt could develop due to flood which contained these fertile soils. In addition, there is good potential of base water flow. It implies that domestic water supply and irrigation farming with appropriate soil conservation measures are possible development activities if base water flow is properly developed.

Furthermore, there are Farmers Training Centers (FTC) in most Kebeles. Three Development Agents (DAs) are stationed at each FTC and one of whom is specialized in Natural Resources. Moreover, some communities have already established Watershed Committees to manage their watershed by themselves. Generally board members of the committees are aware of the importance of natural environment rehabilitation and conservation.

(2) Constraints

Many of the constraints are key limiting factors of other conditions and activities. For instance, farmland suitable for intensive farming is physically limited so some farmers are forced to cultivate on sloping land. Accordingly, it causes more serious soil erosion if there are any intensive prevention measures. In the two thirds of the Study Area, it is considered that careful examination is required before introduction of irrigation scheme due to sloping land.

In the 64 Woredas depth of soil has been becoming shallow as a result of long-term erosion. The annual soil loss is estimated at 11.5 mm on average. The high rate of soil loss causes poor vegetation on the hilly areas and accelerates surface soil erosion with the progressive and selective removal of the lighter particles and organic materials. In addition, though the amount of annual rainfall is not small in most areas, it concentrates in main Kiremt rainy season, especially in July and August. In eastern areas there is small Belg rainy season from March to May: however, the rainfall pattern in this season is unstable and erratic.

Though it is inferred that most parts of the Study Area used to be covered with forests, only a part of natural vegetation remain after the long-term intense land utilization. However, most people in the area still rely on natural resources for fuel, forage, construction etc. That is, there is not enough woody biomass in the area for self-sustenance of rural people. Moreover, most lands have already been distributed to the people and only some steep sloping areas remain as communal land, where we can utilize for rehabilitation and conservation of forest.

3.2 Socio-economic Situation

3.2.1 Demographics

The major ethnic group in the region is Amhara (91.4%). However, other groups such the Agew/Awi (3.6%), Oromo (2.7%) and Agew/Hamyra (1.5%) also exist in the region. Regarding the religious composition of the population, 82.5% are Orthodox Christians, 17.2% Muslims, and 0.2% Protestants.

In the Study Area, population of men is more than that of women in rural areas, while, in urban areas, women population is more than men. (See Table 3.2.1.) Although a few exceptional Woredas are seen, in almost all cases, female population in urban areas is bigger than men even though the total number of female population is less than male.

Table 3.2.1 Population of the 64 Woredas and ANRS

	Male+Female	%	Male	%	Female	%
Population of the 64 Food Insecure Woredas (x 1,000)						
Urban	520	6.82	250	6.55	270	7.09
Rural	7,106	93.18	3,566	93.45	3,540	92.91
Total	7,626	100.00	3,816	100.00	3,810	100.00
Population of ANRS (x 1,000)						
Urban	2,112	12.27	1,024	11.86	1,088	12.69
Rural	15,102	87.73	7,613	88.14	7,489	87.31
Total	17,214	100.00	8,637	100.00	8,577	100.00

(Source: Summary and Statistical Report of the 2007 Population and Housing Census Results, December 2008, National Census Commission)

3.2.2 Education

The current system of formal education is based on a three-tier system: eight years of primary education, followed by four years of secondary school and tertiary education. Prior to the change in the education policy, the education system was based on six years of primary education, followed by two years of junior secondary and four years of senior secondary education and tertiary education (EDHS, 2005).

An investigation of the changes in educational attainment by successive age groups indicates the long-term trend of the country's educational achievement. Survey results of CSA, 2005, showed that there had been a marked improvement in the educational attainment of women. For example, the proportion of women with no education declined significantly from 99 % among women age 65 and over to 41 % among women age 10-14. However, there were only 2-3 % of female and male who completed secondary and higher education in ANRS.

Gross enrolment rates in primary school (age 7-14) of the 64 Woredas are compared in the Figure 3.2.1. The average enrolment rate was 64.4% for male, 56.3% for female and 60.6% for the total. In general, the female gross enrolment rates were lower than that of male. As for the illiteracy rates, male figure (64.3%) is lower than women (72.9%).

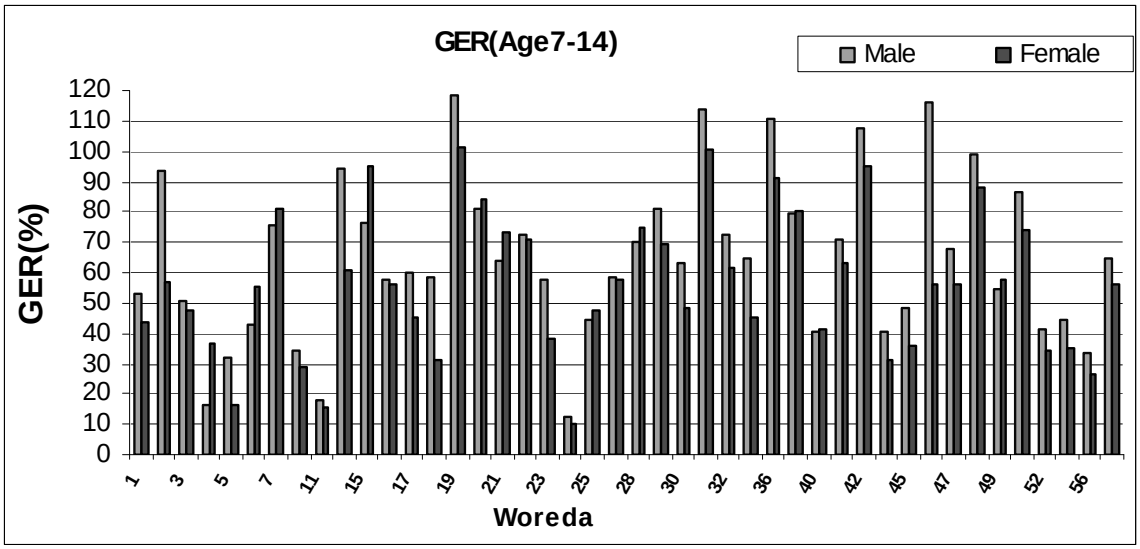


Figure 3.2.1 Gross Enrolment Rates by Woreda

(Note: Some Woredas changed their names and boundaries.)
(Source: Central Statistical Agency, 2005)

1 Abergelie	11 Bugna*[*Also include Lasta]	21 Gazgibela	31 Kalu	41 Meket	53 Were Ilu
2 Addi Arkay	12 Chefe Golana Dewerahmedo	22 Gera Midira Keya Gebriel	32 Kelala	42 Sayint (includes mehal sayint)	54 Wogera
3 Alebuko	Dewa Chefa	Menz Keya	33 Kemekem	43 Shebel Berentta	55 Zikuala
4 Ambassel	Dewa Harewa	Menz Gera	34 Kobo	44 Simada	56 Sehara
5 Angolalla Terana Asagirt	13 Dabat	23 Geshe Rabel	35 Kutaber	45 Soqota	57 Average of 64 Woredas
6 Argoba special	14 Dawuntna/Delanta	24 Gidan	36 Lay Gayint	46 Tach Gayint	
7 Artuma Fursina Jile	15 Debarq	25 Goncha Siso Ensue	37 Legambo	47 Tehuledere	
8 Bati	16 Debre Sina	26 Guba Lafto	38 Legehida	48 Telemt	
9 Belessa (east and west)	17 Dehana	27 Habru	39 Mam Midrina Lalo Midair	49 Tenta	
Mierab Belesa Woreda	18 Dessie Zuria	28 Jama	Menz Lalo Mider	50 Wadla	
Misrak Belesa Woreda	19 Ebinat	29 Jan Amora	Menz Mama Mider	51 Wegde	
10 Beyeda	20 Enebse Sir Midair	30 Jilena Timuga	40 Mekdela	52 Were Babu	

School attendance ratios in combination with repetition and dropout rates described the flow of students through the school system. In countries with an automatic promotion policy, where most students are promoted to the next grade at the end of the school year, repetition rates are almost zero. However, in Ethiopia, the school system does not adopt the automatic promotion of students. (EDHS, 2005)

Table 3.2.2 Repetition and Dropout Rates by School Grade in ANRS

REPETITION RATE					
1st	2nd	3rd	4th	5th	6th
6.6	1.2	1.8	0.6	2.2	0
DROPOUT RATE					
2.4	2.1	3	4	6	1.8

(Note: Data are for the household population age 5-24 years old.)
(Source: Central Statistical Agency, 2005)

In ANRS, repetition rates were higher in lower grades, particularly, the highest in grade one (about 7 %), but there was no consistent tendency for the dropout rates. In the 64 Woredas, there were significant dropout rates according to the household survey conducted by the CSA in 2005. The reasons for dropouts included marriage, involvement in farm activities, low income, remoteness, absence from school and so forth. (See Table 3.2.3.) The early marriage was the biggest reason for dropout followed by farming activities.

Table 3.2.3 Reasons for Dropout in the 64 Woredas **(%)**

Farming Activities	Remoteness of the School	Low Income/ Lack of Material	Marriage
19.47	7.65	6.00	39.01
Migration due to Drought	Sickness	Poor Education Quality	Fear of Danger
10.90	8.78	3.29	4.89

(Source: Central Statistical Agency, 2005)

Another study also researched the reasons for non-attendance at school (PC/MOYs survey of adolescents 10 to 19 in rural Amhara (2004), Boys (n=925) and Girls (n=940)). The result clearly shows that the custom of early marriage affected the non-attendance at school of girls as well as poverty issue to both boys and girls in the rural areas of Amhara.

Table 3.2.4 Reasons for Non-attendance at School by Sex

Reasons for non-attendance at School	Boys (%)	Girls (%)
Family could not afford	46.2	39.9
Too many domestic responsibilities	33.7	14.4
Got married	1.4	30.5
Family does not see the benefit	7.6	7.0
School is too far/no schools	4.3	3.3
Others	6.8	4.9

3.2.3 Health

(1) Mortality Rate and Diseases

The socio-economic survey conducted in the course of the Study in 2008 revealed that adult mortality rate in the 64 Woredas was 9% on average. Since the regional average was 6.15%, the Study Area faced severe condition. The survey also found out the issues on lack of health workers, limited amount of budget, shortage of drugs, shortage of medical equipment, the lack of health institutions and remoteness of the health services.

In the 64 Woredas, the most affecting diseases reported included malaria, pneumonia, diarrhea, gastric enteritis, inflammatory diseases, skin infection, arthritis, intestinal parasitoids, anemia and 'yebet tata' (evil spirit) and 'yewef besheta' (hepatitis). The major sources of drugs included private drug vendors, public health institutions, open markets, common shops and traditional healer.

(2) Conventional and Traditional Health Service

As well as conventional medicine and doctor, traditional medicine and healer were regarded as main option when people fall ill. People in many Woredas, such as Debre Sina, Jamma, Kalu, Kelela etc, Yebet Tata (evil spirits) were taken up as one of serious disease to be treated by traditional health service.

For instance, in Sayint, about 27.5% of the population treated these illnesses by taking traditional medicines and 29.4% of people went to doctors when their sickness got severe. In Kuta Ber, about 20.3% of the population treated these illnesses by taking traditional medicines, while 33.8% of people went to hospitals or clinics when they became sick.

(3) HIV/AIDS

Having knowledge of HIV helps HIV negative individuals make specific decisions to reduce risk and increase safer sex practices so they can remain disease free. For those who are HIV infected, knowledge of their status allows them to take action to protect their sexual partners, to access treatment, and to plan for the future. Testing of pregnant women is especially important so action can be taken to prevent mother-to-child transmission (EDHS, 2005).

The table below shows the awareness of HIV/AIDS in the Study Area. (Refer to the Figure 3.2.1 for Woreda names.) It reveals vast differences between men and women in recognition and consciousness toward HIV/AIDS.

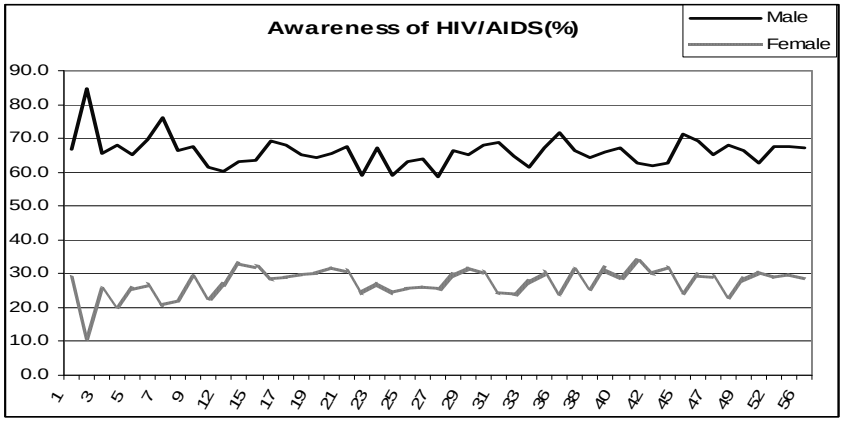


Figure 3.2.2 Awareness of HIV/AIDS by Woreda

(Source: Central Statistical Agency, 2005)

3.2.4 Infrastructure

(1) Road

The road network has not yet well developed in the 64 Woredas. (See Figure 3.2.3.) There are two trunk roads running from north to south, one in the eastern part and one in the north-western part of the Study Area. But these two trunk roads pass on only 14 Woredas. Also there are four link roads and one main access road running in the Study Area. To compliment these roads, there are four collector roads and 19 feeder roads. In the middle of the Study Area, there is a one collector road running from north to south. This road is important for many mountainous Woredas in Wag Himera, North Wollo and South Wollo Zones since there are no major accessible roads such as trunk/link/main access roads. Among the 64 Woredas, there are 10 Woredas where no major roads are running on their territories and they are Telemt, Beyeda, West Belesa, Dawunt, Mehal Sayint, Alebuko, Aregoba, Menze Qeya Gebriel, Menze Lalo Mider and Asagirt.

(2) Electricity

Ethiopian Electric Power Authority supplies electricity to the Study Area and three stations are responsible. The Addis Ababa Central Station supplies electricity to the Woredas in North Shewa Zone, the Amhara West District Station is responsible for the Woredas in North Gondar Zone, and the Amhara East District Station is responsible for most Woredas in the Study Area. However, 16 Woredas are still not able to receive electric power including Aregoba. Electric transmission line has been expanding to Simada during the Study period (confirmed in October 2010). Electrification coverage extension seems to be quite progressive and power transmission line facilities are now being constructed. Electrification development has much potential for future extension in the Study Area.

(3) Water Supply

Bureau of Water Resource Development undertakes the implementation of rural water supply project in the Study Area. As of October 2010, more than 8,000 schemes have been implemented. Population coverage in the Study Area is about 52% according to the latest data. In 2007, population coverage in the Study Area was about 44% so that about 8 % of water supply coverage was improved within 2 years: it can be said 4%/year. However, differences among the areas are very big. (See Table 3.2.5.)

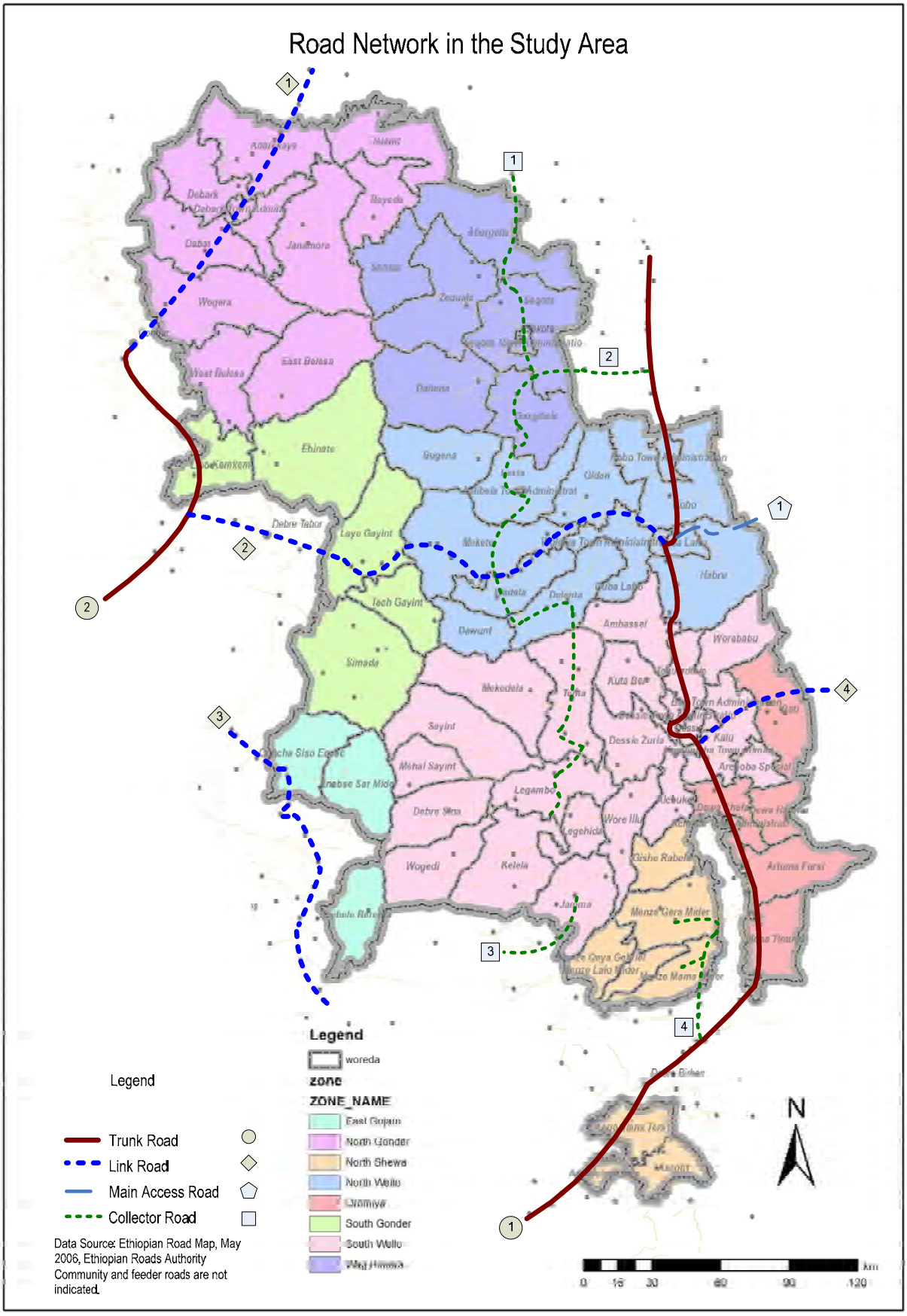


Figure 3.2.3 Road Network in the Study Area

Table 3.2.5 Rural Water Supply Coverage by Woreda

No.	Zone	Woreda	Coverage % in 2009	No.	Zone	Woreda	Coverage % in 2009
1	East Gojam	Enebse Sar Mider	87.90	33	Oromiya	Dewa Harewa	37.83
2	East Gojam	Goncha Siso Enese	55.39	34	Oromiya	Jilena Timuga	45.47
3	East Gojam	Shebele Berenta	78.18	35	South Gonder	Ebinate	42.80
4	North Gonder	Adarekaye	43.43	36	South Gonder	Laye Gayint	52.30
5	North Gonder	Beyeda	53.62	37	South Gonder	Libo Kemkem	67.70
6	North Gonder	Dabat	52.50	38	South Gonder	Simada	38.30
7	North Gonder	Debark	33.17	39	South Gonder	Tach Gayint	60.90
8	North Gonder	East Belesa	30.11	40	South Wello	Alebuko	46.17
9	North Gonder	Janamora	29.18	41	South Wello	Ambassel	52.54
10	North Gonder	Telemt	29.23	42	South Wello	Aregoba Special	23.30
11	North Gonder	West Belesa	36.33	43	South Wello	Debre Sina	42.40
12	North Gonder	Wogera	28.46	44	South Wello	Dessie Zuria	59.67
13	North Shewa	Angolelana Tera	70.29	45	South Wello	Jamma	64.20
14	North Shewa	Asagirt	93.69	46	South Wello	Kalu	48.42
15	North Shewa	Gishe Rabele	62.34	47	South Wello	Kelela	77.63
16	North Shewa	Menze Gera Mider	62.01	48	South Wello	Kuta Ber	72.02
17	North Shewa	Menze Lalo Mider	49.19	49	South Wello	Legambo	65.90
18	North Shewa	Menze Mama Mider	43.86	50	South Wello	Legehida	40.74
19	North Shewa	Menze Qeya Gebriel	50.90	51	South Wello	Mehal Sayint	41.46
20	North Wello	Bugena	59.10	52	South Wello	Mekedela	64.50
21	North Wello	Dawunt	22.51	53	South Wello	Sayint	67.00
22	North Wello	Delanta	44.35	54	South Wello	Tehulederie	68.70
23	North Wello	Gidan	63.77	55	South Wello	Tenta	78.00
24	North Wello	Guba Lafto	42.53	56	South Wello	Wogedi	49.59
25	North Wello	Habru	51.80	57	South Wello	Wore Illu	73.90
26	North Wello	Kobo	45.25	58	South Wello	Worebabu	76.02
27	North Wello	Lasta	45.26	59	Wag Himera	Abergelie	22.69
28	North Wello	Mekete	58.03	60	Wag Himera	Dahena	52.56
29	North Wello	Wadela	53.40	61	Wag Himera	Gazgibela	35.76
30	Oromiya	Artuma Fursi	51.28	62	Wag Himera	Sehala	13.74
31	Oromiya	Bati	44.05	63	Wag Himera	Seqota	37.46
32	Oromiya	Dewa Chefa	77.14	64	Wag Himera	Zequala	87.56
					Average		52.43

(Source: BoWRD, March 2009)

3.2.5 Social and Cultural Dimension

(1) Poverty and Malnutrition

Wealth ranking was conducted in 2008 in the 8 target Woredas. The indicators for the wealth ranking varied from 3 in Ebinate to 10 in Mekedela and there were 17 in total (Landholding size, Oxen, Cow, Ox/cows, Goat, Sheep, Sheep/goat, Donkey, Mules/donkeys, Horse, Camel, Bee hive, Back yard garden size, Eucalyptus tree in hectare, Bags of crop harvested/year, Food deficiency in months and Other income). Landholding size and number of oxen, goat and sheep which were common indicators among them are summarized in Table 3.2.6.

In terms of landholding size, people in Ebinate had bigger land than other Woredas because the landholding size for the very poor category was even 1 hectare as compared to other 5 Woredas, where the landless was defined as the very poor.

In Gidan and Bugena, the landholding size was not considered as an indicator for wealth while number

of oxen and cow was the main indicator for wealth ranking. But the definitions of the well off differed a lot (In Bugena, the well off had 7-10 oxen/cows while it was one large ox in Gidan.) In other 6 Woredas, the definitions were more or less the same. As for the number of goat and sheep, it seemed that those who had more than 10 goats and/or sheep were well off in most Woredas.

The distribution of the poor and very poor was the highest in Gidan (100%), where no better off and middle class lived, followed by Ebinate (85%) and Bugena (82%). On the other hand, in Simada and Kobo, people seemed that the poor and very poor occupied 60%, the lowest distribution.

Table 3.2.6 Results of Wealth Ranking in the 8 Target Woredas

Zone	Woreda	Ranking	Landholding size (ha)	Number of Livestock						Distribution %
				Oxen	Cow	Oxen/cow	Goat	Sheep	Sheep/goat	
South. Gonder	Ebinate	Better off	6	2	3	n/a	n/a	n/a	n/a	10
		Middle	4	2	1	n/a	n/a	n/a	n/a	5
		Poor	2	1	-	n/a	n/a	n/a	n/a	65
		Very poor	1	-	-	n/a	n/a	n/a	n/a	20
	Simada	Better off	3	4	n/a	n/a	n/a	n/a	4	18
		Middle	2.5	2	n/a	n/a	n/a	n/a	3	22
		Poor	1	-	n/a	n/a	n/a	n/a	1	32
		Very poor	-	-	n/a	n/a	n/a	n/a	-	28
North Wollo	Bugena	Better off	n/a	n/a	n/a	7-10	n/a	10-12	n/a	10
		Middle	n/a	n/a	n/a	1-3	n/a	2-3	n/a	8
		Poor	n/a	n/a	n/a	1-2	n/a	None	n/a	22
		Very Poor	n/a	n/a	n/a	-	n/a	None	n/a	60
	Gidan	Better off	n/a	n/a	n/a	1 large ox	n/a	n/a	10 Sheep	0
		Middle	n/a	n/a	n/a	1 cow & 1 ox	n/a	n/a	5 mother sheep	0
		Poor	n/a	n/a	n/a	-	n/a	n/a	1 sheep	50
		Very Poor	n/a	n/a	n/a	-	n/a	n/a	-	50
	Kobo	Better off	4	2	3	n/a	n/a	n/a	8	15
		Middle	2	1	1	n/a	n/a	n/a	5	25
		Poor	1	-	-	n/a	n/a	n/a	2	50
		Very poor	-	-	-	n/a	n/a	n/a	-	10
South Wollo	Aregoba	Better off	1.5	2	3	n/a	12	n/a	n/a	10
		Middle	1	2	1	n/a	8	n/a	n/a	15
		Poor	0.5	-	1	n/a	4	n/a	n/a	65
		Very poor	-	-	-	n/a	3	n/a	n/a	10
	Legambo	Better off	3	2	2	n/a	n/a	n/a	5	15
		Middle	2	1	1	n/a	n/a	n/a	3	20
		Poor	1	1	1	n/a	n/a	n/a	2	50
		Very poor	-	-	-	n/a	n/a	n/a	1	15
	Mekedela	Better off	2.5	2	2	n/a	3	10	n/a	8
		Middle	1.5	1	1	n/a	1	5	n/a	15
		Poor	0.5	-	-	n/a	1	2	n/a	57
		Very Poor	-	-	-	n/a	-	-	n/a	20

(Source: PRA done in the Socio-economic survey, 2008)

During the socio-economy survey conducted in 2008, the weight and height of the PRA participants were measured in 3 Woredas; Simada, Aregoba and Mekedela to calculate the Body Mass Index[10]. The summary results are shown in Table 3.2.7. In terms of average data of Woreda, the three Woredas

[10] Body mass index (BMI) is one of the effective tools for measuring individual poverty level. It is an index that is calculated by dividing the weight (in kilograms) of a person by the square of the person's height (in meters). Values between 18.5 to 25 are within the standard range, and 22 is considered to be the standard value. If the BMI is less than 17.0, the person is considered to be suffering from chronic energy deficiency.

didn't have big differences but the number of those had low values of BMI differed.

Among the 86 rural people measured, those who had the BMI values less than 18.5 counted 29 (13 in Aregoba, 14 in Mekedela and 2 in Simada), 34.1% of the total. Among them, 9 peoples' BMI were lower than 17.0; hence, they were considered to be suffering from chronic energy deficiency (2 in Aregoba, 5 in Mekedela and 2 in Simada; 10.6%). Since the measurement was done with clothes, if the calculation is revised with the assumption that clothes weigh 1 kg, the number of people less than 18.5 increases to 34 (17 in Aregoba, 15 in Mekedela and 2 in Simada; 40%), and those who had less than 17.0 increases to 14 (6 in Aregoba, 6 in Mekedela and 2 in Simada; 16.5%).

Although the numbers of measured differed, the differences among male and female averages were relatively small in all the Woredas. In addition, the age groups didn't have much influence on BMI values because the averages of the age groups were almost the same, ranging from 18.9 to 21.5.

Table 3.2.7 Body Mass Index of the Rural People in Aregoba, Mekedela and Simada

		Aregoba			Mekedela			Simada			
Average	Age Group	Female	Male	Total	Female	Male	Total	Female	Male	Total	Overall Average
	10-19	18.9	18.3	18.7	20.8		20.8				19.2
	20-29	18.6	19.1	18.9	19.3	17.8	18.6	19.7	19.3	19.4	18.9
	30-39		19.3	19.3	16.2	19.3	19.0	20.3	21.1	21.0	19.7
	40-49	17.9	19.4	19.0	18.9	22.1	21.0	19.9	20.1	20.0	19.9
	50-59		18.8	18.8		17.9	17.9		20.8	20.8	19.5
	60-69		19.3	19.3					20.8	20.8	20.0
	70-79								21.5	21.5	21.5
	Average	18.6	19.2	19.0	19.1	19.1	19.1	20.0	20.5	20.4	19.4
		Aregoba			Mekedela			Simada			
Minimum	Age Group	Female	Male	Total	Female	Male	Total	Female	Male	Total	Minimum
	10-19	18.5	18.3	-	20.8		-			-	18.3
	20-29	16.0	17.1	-	16.0	16.3	-	19.7	16.9	-	16.0
	30-39		16.8	-	16.2	14.3	-	20.3	19.0	-	14.3
	40-49	17.9	18.8	-	18.9	21.0	-	16.6	19.6	-	16.6
	50-59		18.8	-		17.8	-		19.1	-	17.8
	60-69		17.8	-			-		20.0	-	17.8
	70-79			-			-		21.5	-	21.5
	Minimum	16.0	16.8	-	16.0	14.3	-	16.6	16.9	-	14.3
		Aregoba			Mekedela			Simada			
Maximum	Age Group	Female	Male	Total	Female	Male	Total	Female	Male	Total	Maximum
	10-19	19.1	18.3	-	20.8		-			-	20.8
	20-29	21.9	22.1	-	23.4	18.9	-	19.7	20.6	-	23.4
	30-39		20.9	-	16.2	24.3	-	20.3	21.8	-	24.3
	40-49	17.9	20.6	-	18.9	23.2	-	22.3	20.4	-	23.2
	50-59		18.8	-		18.0	-		22.8	-	22.8
	60-69		20.8	-			-		21.6	-	21.6
	70-79			-			-		21.5	-	21.5
	Maximum	21.9	22.1	-	23.4	24.3	-	22.3	22.8	-	24.3

Number of People Measured		Aregoba			Mekedela			Simada			Total
	Age Group	Female	Male	Total	Female	Male	Total	Female	Male	Total	
	10-19	3	1	4	1		1				5
	20-29	7	11	18	6	5	11	1	4	5	34
	30-39		5	5	1	9	10	1	6	7	22
	40-49	1	3	4	1	2	3	3	3	6	13
	50-59		1	1		2	2		3	3	6
	60-69		2	2					2	2	4
	70-79								1	1	1
	Total	11	23	34	9	18	27	5	19	24	85

(Source: PRA done in the Socio-economic survey, 2008)

(2) Migration

According to the Population and Development indicators of 2004, the rural-urban migration was on the rise with currently 23.5 % while the urban-rural migration was 15.7 %; much lower than the rural-urban migration rate. (Note that the rural-rural migration with 37.6 % was the highest of the internal migration.) This contributed to an increase in street children who were forced to live in poverty or inferior environments. In addition, grazing land was being depleted through drought or overgrazing, so the subsistence of people who relied on livestock activities was also at a crisis.

(3) Gender Issues

Gender-based discrimination, lack of protection of basic human rights, violence, lack of access to productive resources, education and training, basic health services, and employment were widespread in Ethiopia (National Committee for Traditional Practices Eradication, 2003). With regard to the women's workload in a day, the socio-economic survey in this Study (2008) investigated it through the PRA with women in rural areas. (See Table 3.2.8 and Table 3.2.9.) These data indicate that women's work varied from at home to outside home and from day to night.

Table 3.2.8 Women's and Men's Work in Bugena Woreda

Months	Women's Work	Men's Work
Sene (June-July)	− Help reap the harvest − Carry the harvest	− Reap the harvest − Pile the harvest
Hamle & Nehasse (2nd half of July to 1st week of September)	− Weed the land − Sow their clothes − Spin cotton − Take their grain to the mills	− They shepherd their cattle
Meskerem to Hidar (September to mid- December)	− They weed the land − Help reap remaining harvest − Carry the harvest home	− They plow the land − They reap the harvest − They pile the harvest
Tahsas to Megabit (Mid-December to 1st week April)	− They provide cattle with feed and water	− They dig and prepare the land for planting
Miazia & Ginbot (1st week of April to 1st week of June)	− They weed the land − They pick their grains	− They cultivate their land

(Source: PRA done in the Socio-economic survey, 2008)

Table 3.2.9 Women's Daily Work in Gidan Woreda

Women's 24 hour activity during the Tsedey Season	
Time	Activities
6-7:30am	They prepare breakfast and make coffee
7:30-8am	They collect water
8–9:30am	They collect wood
9:30am-12 pm	They wash clothes
12-2pm	They make injera and cook
2:30-5pm	They pick the grain and grind it
5-6pm	They steer their cattle into their pen
6:30 onwards	They eat dinner, drink coffee, wash the dishes, make Injera dough for the next day prepare their sleeping area and rest
Women's 24 hour activity during the Meher Season	
Time	Activities
6-7:30am	They prepare breakfast and make coffee
7:30-8:30am	They proceed to work
8:30am-4:30pm	They do terracing work
4:30-5:30pm	They return home
5:30-6pm	They collect water
6-7:30pm	They make Injera and cook
7:30-10pm	They eat dinner, drink coffee, wash the dishes, make Injera dough for the next day prepare their sleeping area and rest
Women's 24 hour activity during the Bega Season	
Time	Activities
6-7:30am	They prepare breakfast and make coffee
7:30-8:30am	They clean the cattle pen and prepare the dung for fuel
8:30am-1pm	They prepare the land, and sow grain seeds
1-2pm	They collect feed for their cattle and carry it back home
2-2:30pm	They collect water
2:30-4:30pm	They pick the grain, air it and grind it
4:30-6pm	They make Injera and cook
6-7pm	They tie their cattle and feed them
7-10pm	They eat dinner, drink coffee, wash the dishes, make Injera dough for the next day prepare their sleeping area and rest
Women's 24 hour activity during the Kiremt Season	
Time	Activities
6-7:30am	They prepare breakfast and make coffee
7:30-8am	They clean the cattle pen and prepare the dung for fuel
8-11am	They weed the land
11am-12pm	They collect the weed and carry home to use as feed for the cattle
12-7pm	They make Injera and cook
7-10pm	They eat dinner, drink coffee, wash the dishes, make Injera dough for the next day prepare their sleeping area and rest

(Source: PRA done in the Socio-economic survey, 2008)

(4) Education and Gender

As mentioned above, girls' enrolment in education at all levels was much lower than boys. Female education is hampered mainly by sexual division of labor, which confines girls to household activities; by early marriage; by the unfavorable societal attitude towards the education of girls; and by the restriction on their physical movements in relation to the distance of the school from their homes. Parents, particularly the resource poor ones, would rather invest in their sons, because boys were perceived as bread winners and support for old parents, while girls were preferably employed at the household (NCTPE, 2003).

(5) Health and Gender

The female child mortality rate was 4 % higher than that of male. Higher mortality rates were also observed particularly in the child-bearing (15-49 years) ages. Gender inequality and discrimination

harm girls' and women's health directly or indirectly throughout their life cycle. Fertility rate and maternal mortality were very high with the high prevalence rate of HIV/AIDS, where due to variety of factors women were more affected than men (4 % female and 1 % male). As pointed out earlier, awareness of HIV/AIDS of women was far lower than men in the Study Area. This showed inequality of access to the information between men and women.

(6) Harmful Traditional Practice (HTPs)

Women are suffering from gender-based violence under the guise of tradition and culture but condoned by society. Sexual abuse, rape, marriage by abduction, early marriage, widow inheritance, and bride price, sexual harassment and intimidation at work, educational institutions and working places are common forms of violence faced by women in Ethiopia, which consequently, violate women's human rights.

In this Study, interview was conducted with the organizations concerned such as Women Affairs Bureau, Women's Association, Women's Group in the 8 target Woredas. In respect to the HTPs, all Woredas had consciousness of the issue and this kind of custom had been strongly remained in remote areas. Hence, in Aregoba, Bugena and Kobo, 'Awareness for Harmful Traditional Practice Committee' has been established in each Kebele. The members are health extension workers, Women's Affaire Kebele Office staff, Kebele Administrator, traditional leaders, head of school, etc. They have played crucial roles to mitigate HTPs in the community.

In the case of Aregoba, at the beginning, there was a few who came to report to the committee owing to the fear of excluding from society by reporting. However, the number of report had increased and more women had come to the office. According to the committee staff, the changes of attitude and mindset had been led by the continuous activities with patience for community people to create awareness. Gender issue is related to the culture and historical background and, therefore, it is delicate, sensitive and not facile to change the situation. In the case of Legambo, gender education has been conducted at primary school in cooperation with Women Affairs Bureau. Low awareness of parents makes the HTPs, such as early marriage, continue. In order to tackle the gender issues, society would need to be involved in the long term.

3.2.6 Development Potentials and Constraints

There are some major characteristics observed in the Study Area, such as the large number of rural population, more number of female urban dweller than men, and gender disparity in many aspects.

The large number of rural population could be both a constraint and a potential. If the livelihood of the rural population doesn't change to a sustainable way, this large population continues consuming various natural resources, which in turn may result in enormous resource depletion. If the regional/local administration could lead the rural population to an appropriate direction such as natural resource regenerating activities, the problems in the Study Area such as food insecurity and poverty could be reduced.

Women in urban areas can be mobilized and involve in some kinds of development activities. For

instance, if they are employed as trainers for income generation activities and/or field staff for gender issues, they can contribute to the improvement of gender disparities. However, further research will be necessary to investigate the reason why women live more than men in urban areas.

Gender issues have influences on many sectors; education, health, access to credit, etc. It can be said that gender disparity has become a bottleneck of community development to a certain extent. However, gender itself is, like poverty, a cross-cutting issue and has various dimensions. Therefore, the viewpoint of gender issues should be incorporated into all the activities and implement them in sector-wide. Mitigation of gender inequality will accelerate the improvement of socio-economic condition.

It was revealed that individualism was very strong among the rural people, which makes common/cooperative works very difficult to be implemented smoothly. There seemed to be some joint works and mutual supports by kinships and/or blood relatives but it could mention that group works with unrelated persons were very difficult to be executed easily. (This might result from the negative images to cooperatives experienced during the previous socialist regime.) Accordingly, it seemed that it was also very difficult for the rural people to sustainably operate and maintain public facilities/resources such as communal lands/forests/grazing lands and water points, etc.

It was also found that many specific units for weight and measure were being used for farm produce at different places. For instance, one unit for firewood was ‘the amount of firewood that can be carried by a person’, which is possible to be varied considerably by personal ability and/or physical strength. Presently, due to the poorly developed road networks, not so many agricultural produce had been marketed on a large scale. However, the current various weights and measures may cause stagnation and delay in the agricultural marketing system if much farm produce is marketed after the progress of the road network development. Appropriate and accurate measuring is indispensable for a good agricultural marketing system; hence, unification of the present various weights and measures should be tackled in the future.

The prevalent poverty situation in the 64 Woredas is multifaceted which requires various concerted efforts including food security, education issues, health issues, infrastructure development, etc. Since these sector issues are often interrelated each other (e.g. Education issues include improvement of gender disparities at the same time.), multi-purpose activities seem to be effective. On the other hand, it is also important to tackle each sector issue independently to raise standard of the sector as a whole because many standards are still at low levels. With the progress of decentralization processes in Ethiopia, each Woreda Administration needs to expedite sector development activities with their line agencies in coordination with other activities conducted by donor agencies/NGOs.

3.3 Agriculture and Livestock[11]

3.3.1 Land Tenure and Land Holding

(1) Land Tenure System

The current land tenure system in Ethiopia was established through the land reform followed by the Public Ownership of Rural Lands Proclamation of 29 April 1975, which abolished a feudalistic land tenure system under the old regime. Under the current system, all the rural lands are placed under the ownership of the state and the peoples in Ethiopia and farming communities are given land use right of farmlands for their farming activities.

Land use right is vested only to those who domiciled in a community (village) and the transaction on the right is prohibited, while the right can be taken over by inheritance or rented to others living in the same community under a tenancy arrangement. In case of commercial farming, the state provides land use right to an investor under a lease arrangement.

The land registration and certification program for the authorization of farmers' land use right have been carried out in all the Woredas in ANRS from 2003. Under the program, total of about 3.2 million farmers holdings (about 98% of total farmers holdings) were registered and 1.7 million holdings (about 52% of total) were provisionally certified under the traditional system based on the cultivated land size at the time of land distribution. Currently, the so called modern land certification project (ISLA, Information System of Land Administration) being supported by SIDA are on-going in 19 Woredas in ANRS and about 60,000 farmers' holdings had been registered under the modern system by July, 2008. In the target Woredas, the modern system had been introduced in Ebinate in 2008 and in Kobo and Legambo in 2009.

(2) Land Holding

The decrease of land holding size per farm household and the dispersion of farmland are reported in Ethiopia. According to CACC, the average land holding size was estimated at 1.10ha/farm household and the average number of plots per farm household was at 4.6 in 2001/02 in ANRS.

The average holding size of farmland in the Study Area is estimated to be 0.93 ha/farm household and is smaller than that of 1.10 ha in ANRS. However, there are some differences in the holding sizes among the Woredas and they range from 0.49 ha to 1.97 ha/household. The land holding size per farm household in the 8 target Woredas are similarly estimated as follows;

Table 3.3.1 Average Land Holding Size per Farm Household in the 8 Woredas (2001/02)

Bugena	Gidan	Kobo	Ebinate,	Simada	Aregoba	Legambo	Mekedela	ANRS
0.80ha	0.60ha	0.79ha	0.99ha	1.05ha	0.56ha	0.88ha	0.75ha	1.10ha

Note: Holding size for Aregoba is the same of Kalu Woreda Source: JICA Study Team

The farmlands owned by the farm households of holding size of less than 1.0ha accounts for 38%, 58%, 40%, 27%, 25%, 59%, 43% and 48%, respectively for Bugena, Gidan, Kobo, Ebinate, Aregoba,

[11] Descriptions on statistic figures in this section are based on Ethiopian Agricultural Sample Enumeration 2001/02, Results for Amhara Region, CACC, if not specifically mentioned.

Legambo and Mekedela. In ANRS, the figure is 24%, which means that the land holding size in the 8 target Woredas are smaller than the average in ANRS as shown in the following table.

Table 3.3.2 Area of Farmland by Size of Holding, Rural & Urban

Woreda	Average Holding Size (ha)	Percent Area by Holding Size (%)						Avg. Size per Parcel (ha)	No. of Parcel per Holder
		Under 0.1	0.1 ~ 0.5	0.51~1.00	1.01~2.00	2.01~5.00	5.01~		
Ebinate	0.99	0.3	7.5	18.8	46.6	26.9	0	0.23	4.3
Simada	1.05	0.2	6.3	18.1	49.9	25.5	0	0.20	5.1
Bugena	0.80	0.4	12.7	24.9	44.4	15.6	2.0	0.20	4.0
Gidan	0.60	0.6	21.9	35.5	32.3	9.7	0	0.15	4.0
Kobo	0.79	0.6	12.1	27.6	38.0	20.1	1.7	0.19	4.2
Mekedela	0.75	0.2	14.4	33.1	44.7	7.6	0	0.13	5.8
Legambo	0.88	0.2	9.1	33.8	43.5	13.5	0	0.13	6.6
Aregoba 1/	0.56	0.8	26.8	31.3	34.0	7.0	0	0.13	4.1
Amhara Region	1.10	0.3	6.1	17.4	39.3	33.9	3.1	0.24	4.6

1/: Represented by figure of Kalu Source: Ethiopian Agricultural Sample Enumeration, 2001/02, Results for Amhara Region, Part I, CACC

No data on landless farmers in the Study Area were available. However, according to EEA/EEPRI[12], the proportion of the landless farmers is estimated at around 10% in ANRS based on the sample survey.

3.3.2 Land Suitability

Based on the soil map prepared by the Woody Biomass Inventory and Strategic Planning Project (WBISPP), the present soil conditions in the Study Area are reviewed. In the map, the soils are classified by the FAO/UNESCO soil classification system. The map was originally prepared at a scale of 1:1,000,000 by UNDP/FAO by way of an interpretation of the Landsat images supported by past soil survey reports, field traverses and agro-climatic data.

(1) Effective Soil Depth

The distribution of soils with shallow effective depth due to natural and accelerated erosion in the past is one of the most serious agronomic constraints in the Study Area. The distribution of the soils by effective depth is presented in the following table.

Table 3.3.3 Distribution of Soils by Effective Depth in the Study Area and 8 Target Woredas

Effective Soil Depth	Study Area	Ebinate	Simada	Bugena	Gidan	Kobo	Mekedela	Legambo	Kalu 1/
	%	%	%	%	%	%	%	%	%
<10 cm	5	0	0	0	0	0	0	0	0
10-25 cm	52	25	57	83	52	55	94	70	75
25-50 cm	37	72	41	17	48	21	3	30	25
50-100 cm	1	0	0	0	0	0	0	0	0
100-150 cm	4	3	2	0	0	0	3	0	0
>150 cm	1	0	0	0	0	24	0	0	0
Total	100	100	100	100	100	100	100	100	100

1/: Including Argoba Special Woreda territory *Source: Ethiopian Highland Reclamation Study (1986)*

About 60% of the soils in the Study Area have shallow soils with effective depth less than 25cm. The situation is worse in the target 8 Woredas and over 70% of the soils in the 4 Woredas of Mekedela,

[12] Research Report on Land Tenure and Agricultural Development, EEA/EEPRI, 2002

Bugena, Aregoba (Kalu) and Legambo have shallow effective soil depth. Almost all the soils in the Woredas have effective depth of less than 50 cm except the soils in Kobo. Further soil losses in farmlands with such shallow soil depth should be avoided by all possible measures to ensure the sustainability of farming activities in the Woredas. **(However, these figures appear to be doubtful from field observations in the target watersheds. Effective soil depths in the watersheds are generally deeper than the ones expected from the said data.)**

(2) Land Suitability Classification

The comprehensive reconnaissance level land suitability classifications of the land resources in Ethiopia were made in "Land Resources Inventory for Land Use Planning, Technical Report No.1 (the Report)". Land suitability evaluation system applied in the Report is the system proposed in "Framework for Land Evaluation (FAO, 1976)".

The areal extents of individual suitability classes for the production of major crops are as shown in the table below. More than about 60% of the lands in the Study Area were assessed as not suitable for upland crops production (wheat, teff) under both low-medium production level and high production level. Similarly, majority of lands in the target Woredas are classified as not suitable for the crops production as shown in the table, which might indicate substantial extent of farmlands in the Area were developed in the lands not suitable for crop production. However, as substantial lands in the Area and target Woredas are currently used for upland crop production under sustainable production level, detail study on soils and land suitability classification will be essential for future agricultural development planning.

Table 3.3.4 Land Suitability Classification of the Study Area and 8 Woredas by Crop

Land Suitability for Wheat Production — Unit: %

Suitability Class 1/	Study Area	Ebinate	Simada	Bugena	Gidan	Kobo	Mekedela	Legambo	Aregoba
S1/S1	0	2	0	0	0	0	0	0	0
S2/S1	12	2	14	0	30	21	10	10	0
S2/N	29	52	12	16	0	50	13	0	0
N/S2	0	0	0	0	0	0	0	0	0
N/N	59	44	73	84	70	29	76	90	100
Total	100	100	100	100	100	100	100	100	100

Land Suitability for Teff Production — Unit: %

Suitability Class 1/	Study Area	Ebinate	Simada	Bugena	Gidan	Kobo	Mekedela	Legambo	Aregoba
S1/S1	2	0	9	0	0	0	0	0	0
S1/S2	1	4	0	0	0	0	0	0	0
S2/S1	11	0	0	0	27	23	6	4	0
S2/N	23	52	7	17	0	39	17	9	0
N/S1	0	0	0	0	0	0	0	0	0
N/N	63	44	84	83	73	39	77	87	100
Total	100	100	100	100	100	100	100	100	100

1/: Land suitability class for low-medium production level/high production level
Source: Woddy Biomass Inventory and Strategic Planning Project (WBISPP)

3.3.3 Crop Production and Farming System

(1) Major Crops

In the Study Area, crops grown are mainly cereals, pulses and oil crops. Root crops are of much less importance and production of vegetables and permanent crops are very limited. However, being located in the wide range of agro-climatic zones, varieties of crops are grown as reported in the CSA statistics. Among such crops, common ones in the Study Area are enumerated in the following table.

Table 3.3.5 Crops Cultivated Common in the Study Area

Type	Major Crops	Type	Major Crops
Cereal	Wheat, barley, teff, maize, sorghum, millet	Vegetables	Onion, garlic, pepper, tomato, cabbage,
Pulse	Horse beans, haricot beans, field peas	Fruits	Banana, orange, papaya, guava
Oilseed	Niger seed, linseed, rape seed, safflower	Stimulant	Hop, coffee, chat
Root Crops	Potato, sweat potato, red beet, taro		

Source: CSA statistics

Within the limitations set by the availability of water, the altitude determines the type of crops grown in the Study Area. The higher altitudes above 1,700 m have the bulk of the temperate zone crops. In the lower parts, sorghum and maize become more prevalent.

(2) Cropping Season

The most important climatic limitation for crop production in the Study Area is the amount and distribution of rainfall. Annual rainfall varies from over 1,200 mm in the southeast of the Area to less than 700 mm in the northeast. However, rainfall is not evenly distributed throughout a year. In the Study Area, there is essentially a three-month main rainy season, peaking in July and August. In the southern highlands, however, a minor peak comes in March-April, followed by a significantly dry spell of May and June before the main rainy season. There exist two cropping seasons of *meher* (main rainy season) and *belg* (short rainy season) in ANRS and the Study Area as well. In the Study Area, the *meher* season is a main cropping season from June to December when almost all the temporary crops land planted with annual crops. The *belg* season is a secondary cropping season from late January to end June/early July when crop production is carried out only a part of temporary crops land. Major crops in the both cropping seasons and general cropping calendar are shown in the table below.

Table 3.3.6 Cropping Seasons and General Cropping Calendar

Meher Season	Planting	Beginning of June to July
	Harvesting	Beginning of November to end December
	Major crops	Wheat, barley, teff, oil seeds, pulse
		Maize (late crops; planting Apr./May ~ harvesting Oct.)
		Sorghum (late crops; planting Apr./May ~ harvesting Nov./Dec.)
Belg Season	Planting	Late Jan. to Middle March
	Harvesting	May to end June/early July
	Major crops	Teff, barley, wheat, haricot beans, mug beans, field peas

Source: JICA Study Team

The prevailing cropping calendars in the target Woredas are reported as shown in the following table.

Table 3.3.7 Prevailing Cropping Calendars in the 8 Woredas

	Prevailing Cropping Calendar	
Freda	Belg Crops	Meher Crops
Ebinate	No cropping	Early Apr./End July to Early Oct./End Dec.
Simada	No cropping	Early Apr./End July to Early Oct./End Dec.
Begun	No cropping	Early June /Mid. Aug to Early Nov./End Dec.
Kobo	End Jan/Early Feb to May/June	End Apr. to End Nov.
Mekedela	Mid. /End Jan. to Mid. June/Early July	Early June/Mid Aug. to Early Nov. End Dec.
Legambo	Jan. to June	Mid June to December
Aregoba	Jan. 20/Mar.10 to June 10/July 15	June 25/July 25 to Oct. 20/Dec. 20

Source: Questionnaire survey by the Study Team

(3) Cropping System

Cropping systems adopted by farmers involve a wide range of crops and differ from one locality to another. Mixture of crops grown is selected to meet needs of farmers and cropping calendars are designed to spread their workloads. Farmers plant crops so that they mature in adequate conditions or to fill a food gap. Cropping systems adopted in the Study Area appear to be much diversified with a number of crops involved. Further, cropping systems adopted by farmers are complex involving systems which cannot be equated only with edaphic land qualities.

Because of the peasant-based economy of the country, the differentiation of crops produced according to their environmental suitability becomes somewhat diffused. This is due to the fact that, in search of security, individual farmers produce or at least attempt to produce the total range of crops necessary for their survival. It will be necessary in the future, with increased development, communication and therefore exchangeability of goods and products, to encourage farmers to concentrate on crops whose optimum environmental conditions are met by the lands on which they live. This would be a way to optimize the productivity of their lands.

(4) Cropped Area and Cropping Intensity[13]

Annual cropped areas of temporary crops in the Study Area and target Woredas estimated by CACC are summarized in the following table. The major crops in the Study Area are teff, barley, sorghum, wheat and pluses.

Table 3.3.8 Cropped Areas of Temporary Crops in the Study Area and the 8 Woredas

Unit: ha

Crops	Study Area	Ebinate	Simada	Bugena	Gidan	Kobo	Mekedela	Legambo	Kalu 2/
Cereals	1,001,917	24,553	30,909	26,729	15,378	30,642	14,345	25,145	18,673
Wheat	161,773	3,334	3,467	3,747	3,280	671	2,329	4,568	650
Teff	316,888	10,874	17,270	11,787	1,415	10,351	6,133	1,576	5,032
Barley	205,685	3,242	3,244	5,589	7,577	1,470	3,986	17,008	598
Maize	59,231	2,705	2,609	988	715	3,589	145	-	1,480
Sorghum	203,744	2,923	3,741	4,408	992	14,414	1,384	1,134	9,442
Pulses 3/	320,463	13,088	14,015	8,083	6,771	3,096	7,197	9,456	1,856
Oil Seeds	39,108	1,979	2,309	538	174	280	395	618	158
Vegetables	7,038	0	20	0	45	278	16	13	99
Root Crops	11,462	706	1,329	0	235	15	37	130	26
Others	42,430	233	86	92	0	114	0	82	20
Total	1,367,822	40,559	48,668	35,442	22,603	34,425	21,990	35,444	20,832

1/: Cropped areas estimated by CACC 2/: Including territory of Aregoba Woreda 3/: Cropped area of horse beans in Ebinate 5,595ha

Source: Ethiopian Agricultural Sample Enumeration, 2001/02, Results for Amhara Region, Part I, CACC

The primary and secondary crops (crops having the 2nd largest cropped area) in the Woredas are shown below.

Table 3.3.9 Primary & Secondary Crops in the 8 Woredas

Item	Ebinate	Simada	Bugena	Gidan	Kobo	Mekedela	Legambo	Aregoba
Primary	teff	teff	teff	barley	teff	teff	barley	sorghum
Secondary	faba beans	wheat	barley	wheat	sorghum	barley	wheat	teff

Note: Aregoba represented by Kalu Source: Ethiopian Agricultural Sample Enumeration, 2001/02, CACC

The annual cropped areas of temporary crops and the proportion of cropped areas in belg season to

[13] Study based on CACC's Agricultural Sample Enumeration, 2001/02, as accessibility to other data limited.

those of meher season in the Study Area are as shown in the following table.

Table 3.3.10 Cropped Area of Belg Crops in the Area

Annual Cropped Area (ha)	1,367,822
Cropped Areas in Meher Season (ha)	1,247,173
Cropped Areas in Belg Season (ha)	120,649
Proportion: Belg/Meher (%)	9.7

Source: Ethiopian Agricultural Sample Enumeration, 2001/02, CACC

Similarly, the same of the 8 target Woredas are as summarized below.

Table 3.3.11 Cropping Intensity & Proportion of Cropped Areas in Belg to Meher in the 8 Woredas 1/

Unit: ha

Crops	Ebinate	Simada	Bugena	Gidan	Kobo	Mekedela	Legambo	Kalu 2/
Temporary Crops Land (ha)	39,790	46,832	35,641	17,257	33,496	20,594	20,894	18,829
Annual Cropped Area (ha)	40,559	48,668	35,442	22,603	34,425	21,990	35,444	20,832
Annual Cropping Intensity (%)	102	104	99	131	103	107	170	111
Cropped Areas in Meher Season (ha)	39,731	46,644	35,442	17,006	31,974	20,449	20,612	18,473
Cropped Areas in Belg Season (ha)	828	2,024	0	5,597	2,451	1,541	14,832	2,359
Proportion: Belg/Meher (%)	2	4	0	33	8	8	72	13

1/: Cropped areas estimated by CACC 2/: Including territory of Aregoba Woreda

Source: Ethiopian Agricultural Sample Enumeration, 2001/02, Results for Amhara Region, Part I, CACC

The annual cropping intensities in the target Woredas are in the range of 99% in Bugena to 170% in Legambo and the proportions of belg season cropped areas to those in meher season are 0% in Bugena to 72% in Legambo as shown in the table. It could be said that temporary crop production in the belg season is commonly practiced in Legambo and Gidan. While, a single cropping in the meher season is prevailing in other Woredas. Production of permanent crops is rather limited compared to the temporary crops in the 8 target Woredas as shown in the following table.

Table 3.3.12 Planted Area of Permanent Crops in the 8 Woredas

Unit: ha

Ebinate	Simada	Bugena	Gidan	Kobo	Mekedela	Legambo	Kalu 2/
79	107	limited	62	131	limited	41	822

1/: Cropped areas estimated by CACC 2/: Including territory of Aregoba Woreda

Source: Ethiopian Agricultural Sample Enumeration, 2001/02, Results for Amhara Region, Part I, CACC

Major permanent crops in the Study Area are coffee and chat, and those in the 8 target Woredas are hop in Kobo, Gidan, Ebinate & Simada and chat and coffee in Kalu.

(5) Cropped Area of Temporary Crops per Farm Households

Average annual cropped areas of temporary crops per farm household is 0.82 ha in the Study Area and, in the 8 target Woredas, they are in the range of 0.53 in Kalu (representing Aregoba) and 1.05 ha in Simada and limited to 0.82 ha on average as shown in the table below.

Table 3.3.13 Annual Cropped Areas of Temporary Crops per Farm Households 1/

Unit: ha

Crops	Study Area	Ebinate	Simada	Bugena	Gidan	Kobo	Legambo	Mekedela	Kalu 2/	Amhara
No. of Farm Households (No.) 3/	1,670,139	42,018	46,102	46,460	34,563	43,337	35,309	31,172	39,518	2,994,056
Annual Cropped Area (ha/household)	0.82	0.97	1.06	0.76	0.65	0.79	1.00	0.71	0.53	0.97
Cropped Areas in Meher Season (ha/household)	0.75	0.95	1.01	0.76	0.49	0.74	0.58	0.66	0.47	0.07
Cropped Areas in Meher Season (ha/household)	0.07	0.02	0.04	0.00	0.16	0.06	0.42	0.05	0.06	1.05

1/: Cropped areas estimated by CACC 2/: Including territory of Aregoba Woreda 3/: Total of crop producing holders & (crop + livestock) producing farmers

Source: Ethiopian Agricultural Sample Enumeration, 2001/02, Results for Amhara Region, Part I, CACC

(6) Crop Yield and Production

The yields of temporary crops in the Study Area and the 8 target Woredas are presented in the table.

Table 3.3.14 Yield of Temporary Crops in the Study Area and the 8 Woredas 1/

Unit: ton/ha

Crops	Season	Study Area	Ebinate	Simada	Bugena	Gidan	Kobo	Mekedela	Legambo	Kalu 2/	Amhara
Cereals	Meher	1.1	0.84	0.78	0.77	1.14	1.30	0.98	1.25	1.53	1.22
	Belg	0.4	-	-	-	-	0.06	0.07	0.39	0.33	0.48
Wheat	Meher	1.1	1.16	0.90	0.81	0.99	1.45	1.27	1.12	1.22	1.24
	Belg	0.3	-	-	-	0.12	-	-	-	1.34	0.71
Teff	Meher	1.1	0.72	0.65	0.63	0.89	0.87	0.84	0.61	1.11	0.90
	Belg	0.3	-	-	-	0.07	0.07	-	-	-	0.72
Barley	Meher	1.2	0.85	0.83	0.99	1.21	1.70	1.19	1.50	1.13	1.14
	Belg	0.3	-	-	-	-	0.20	0.07	0.34	0.26	0.31
Maize	Meher	1.2	1.10	1.30	0.66	1.21	-	1.01	-	1.49	2.15
Sorghum	Meher	1.1	0.65	0.84	0.86	1.46	1.62	0.64	1.10	1.78	1.28
All Pulses	Meher	1.0	0.94	0.75	0.73	1.09	1.11	0.95	0.92	1.04	1.01
	Belg	0.4	-	-	-	0.05	0.11	-	0.15	-	0.34
All Oil Seeds	Meher	0.5	0.30	0.34	0.59	0.45	0.28	0.51	0.44	1.01	0.48

1/: Yield estimated by CACC 2/: Including territory of Aregoba Woreda

Source: Ethiopian Agricultural Sample Enumeration, 2001/02, Results for Amhara Region, Part I, CACC

The yield levels of temporary crops in both the Study Area and the 8 target Woredas appear to be still low compared with the potential yield levels due primarily to crop production under traditional farming practices and under rainfed conditions. The yield levels of belg crops are miserably low due possibly to drought or water shortage, which indicates instability of crop production in the season. The estimated productions of temporary crops in the Study Area and the target Woredas are presented in the following table.

Table 3.3.15 Productions of Temporary Crops in the Study Area and the 8 Woredas 1/

Unit: 1,000 ton

Crops	Study Area	Ebinate	Simada	Bugena	Gidan	Kobo	Mekedela	Legambo	Kalu 2/	Amhara
Cereals	1,000.0	20.7	24.1	20.6	13.8	38.0	13.3	22.6	26.4	2,771.1
Wheat	174.0	3.9	3.1	3.0	3.1	1.0	2.9	4.6	0.5	362.8
Teff	352.4	7.9	11.3	7.4	1.0	8.6	5.1	1.0	5.0	706.8
Barley	201.3	2.7	2.7	5.5	7.0	2.2	3.9	14.5	0.4	335.2
Maize	65.3	3.0	3.4	0.7	0.1	0.0	0.1	0.0	2.2	650.2
Sorghum	228.9	1.9	3.2	3.8	1.5	23.3	0.9	1.2	16.8	522.6
Pulses	290.2	12.3	10.0	5.9	5.1	2.6	6.2	5.3	1.3	506.1
Oil Seeds	19.3	0.6	0.8	0.3	0.1	0.1	0.2	0.3	0.2	84.9
Root Crops	66.3	0.7	3.0	0.0	2.4	0.2	0.5	1.1	0.3	499.0
Vegetables	8.3	0.0	0.1	0.0	0.1	0.9	0.1	0.1	0.4	33.9

1/: Yield estimated by CACC 2/: Including territory of Aregoba Woreda

Source: Ethiopian Agricultural Sample Enumeration, 2001/02, Results for Amhara Region, Part I, CACC

From the production volumes of cereals, the 8 target Woredas can be grouped into 5 groups by a combination of primary and secondary cereals as follows;

Primary Crop – Secondary Crop				
Teff - Barley	Barley - Wheat	Sorghum - Teff	Teff - Wheat	Teff - Maize
Bugena, Mekedela	Gidan, Legambo	Kobo, Kalu	Ebinate	Simada

The bulk of agriculture in the Study Area is still fairly primitive with concomitant low productivity. It is necessary to study and evaluate farming systems and practices to enable improvement of such systems and practices within their own environments.

(7) Prevailing Farming System

The prevailing farming systems in the Study Area could be defined as a complex system of crop production and livestock farming based on the CSA Sample Survey as shown in the following table.

Table 3.3.16 Farming Systems in the Study Area

Proportion of Farm Households by Farming Systems Adopted (%)		
Crop Only	Crop + Livestock	Livestock Only
19	74	6

Source: Agricultural Sample Enumeration 2001/02, Amhara Region, CSA

(8) Irrigated Farming in the 8 Target Woredas

Some information on the irrigated farming in the target Woredas are presented in the following table. Irrigation developments in the target Woredas are rather limited except Mekedela and the small-scale river diversion system is a main stay as shown in the table. Irrigation farming is mainly practiced in belg season and major crops cultivated are various kinds of vegetables. In the target watershed in Mekedela, a reservoir is constructed and gravity irrigation areas of some 180ha are developed. Main irrigation methods appear to be a sort of flood irrigation, the introduction of furrow irrigation is considered essential for the efficient utilization of valuable water resources and productivity improvement.

Table 3.3.17 Irrigated Areas in the 8 Woredas (2008)

Woreda	Year	Irrigated Area (ha)	No. of Beneficiaries (No.)	Irrigated Area/Farmer (ha)	Irrigation Systems	Irrigation Season	Major Crops
Ebinate	2007	586	4,650	0.13	river diversion, pumping, dug well	mostly in belg season	
	2009 1/	692	-	-			vegetables
Simada	2008	350	-	-	river diversion, pumping, dug well	belg season	
	2009 1/	702	-	-			
Bugena	2008	36	-	-	river diversion, spring, water harvesting pond	both meher/belg	vegetables
	2009 1/	88	-	-			
Gidan	2007	1,344	9,860	0.14	-	belg season	-
Kobo	2006	2,363	4,907	0.48	-	belg season	-
Legambo	2008	1,887	-	-	modern river diversion (38 schemes), traditional river diversion (÷150 schemes), spring, pond	belg season	wheat, barley, spice, vegetables
	2009 1/	2,664	-	-			
Mekedela	2008	4,943	21,690	0.23	modern river diversion (7 schemes), traditional river diversion (÷150 schemes), spring, 2 reservoirs, pond	belg season	vegetables, lentil, spice
	2009 1/	5282	24,691	0.21			
Aregoba	2008	200	-	-	-	belg season	vegetables

1/: Plan *Source: WAO & CDC report*

3.3.4 Livestock

(1) General

The livestock sub-sector is another important economic activity of farm households in the Study Area and 8 target Woredas. In addition, draft cattle are primary sources of labor for land preparation and transport of farm products. However, livestock husbandry in the areas is still at the stage of rather less

intensive being placed priority on number of animals rather than productivity. Cattle are generally stocked as assets and small ruminants are usually kept to cope with food insecurity. Accordingly, the sub-sector faces unstable and low productivity. Major constraints of the livestock sub-sector include problems in animal health, raising practices, genetic resources and feed supply.

(2) Livestock Population and Holding sizes

The livestock population and the holding size per household in the Study Area are summarized in the following table.

Table 3.3.18 Livestock Population by Type of Animal in the Study Area

Unit: 1,000 head

Woreda	Type of Animal								Total Livestock Unit 1/	Beehives	No. of All Holders 2/	Livestock Unit per Household	Animal Holding per Household	
	Cattle	Sheep	Goat	Horse	Ass	Mule	Camel	Poultry					Cattle (No.)	Sheep/Goat (No.)
Study Area	4,995	3,545	2,658	135	808	61	16	6,617	6,418	434	1,670,139	3.8	3.0	3.7
Amhara Region	10,513	5,320	3,816	306	1,465	106	28	3,435	12,932	917	3,255,768	4.0	3.2	2.8

1/: Estimated by goat/sheepx0.1+horse/ass/mulex0.7+camelx2+poultryx0.01+cattlex1 2/: Total of (crop + livestock + crop & livestock) holders

Source: Ethiopian Agricultural Sample Enumeration, 2001/02, Results for Amhara Region, CACC

The population of livestock in the 8 Woredas expressed in live stock unit (LU) is in the range of 113,000 in Gidan to 185,000 in Kobo. The holding size per farm household is in the range of 3.1 LU in Gidan to 4.0 LU in Kobo. The holding size of small ruminants appears to be high in Legambo and Gidan, where majority of their territories are located in the Agro-climatic zone of Dega. Apiculture is common in Ebinate, Bugena and Simada as shown in the following table.

Table 3.3.19 Livestock Population by Type of Animal and Woreda

Woreda	Type of Animal (1000 heads)								Total Livestock Unit 1/ (1000 LUs)	No. of Beehives (1000 hives)	No. of All Holders 2/	Livestock Unit per Household	Animal Holding per Household	
	Cattle	Sheep	Goat	Horse	Ass	Mule	Camel	Poultry					Cattle (No.)	Sheep/Goat (No.)
Ebinate	124	33	70	1	23	1	1	190	155	19	43,517	3.6	2.8	2.4
Simada	131	81	97	1	25	2	0	159	169	12	49,358	3.4	2.7	3.6
Bugena	137	64	80	0	27	2	0	198	174	15	49,375	3.5	2.8	2.9
Gidan	82	115	42	0	18	2	0	125	113	4	36,256	3.1	2.3	4.3
Kobo	155	9	62	0	20	1	3	212	185	5	46,745	4.0	3.3	1.5
Legambo	83	203	23	7	20	1	0	94	126	3	37,583	3.4	2.2	6.0
Mekedela	91	106	47	1	20	1	0	78	122	7	32,753	3.7	2.8	4.7
Aregoba 3/	115	13	68	0	13	1	2	205	139	6	40,766	3.4	2.8	2.0

1/: Estimated by goat/sheepx0.1+horse/ass/mulex0.7+camelx2+poultryx0.01+cattlex1

2/: Total of (crop + livestock + crop & livestock) holders 3/: Represented by figures of Kalu where Aregoba territory was involved.

Source: Ethiopian Agricultural Sample Enumeration, 2001/02, Results for Amhara Region, CACC

(3) Genetic Resources

Poor genetic resources of animals are reported as a reason for low productivity in the Study Area and 8 target Woredas. Indigenous cattle are almost exclusive in both the areas as shown below.

Table 3.3.20 Number of Cattle by Sex and Breed in the Study Area & the 8 Woredas

Unit: head

Woreda	Male			Female			Total
	Indigenous	Hybrid	Exotic	Indigenous	Hybrid	Exotic	
Ebinate	64,821	0	0	59,049	0	*	123,872
Simada	68,734	*	*	61,901	*	54	130,707
Bugena	69,308	0	0	67,616	0	0	136,924
Gidan	39,668	0	0	42,673	0	0	82,341
Kobo	77,250	*	*	77,127	*	*	154,724
Mekedela	43,409	0	*	47,103	0	0	90,551
Legambo	37,802	*	*	44,052	*	*	82,532
Aregoba 1/	61,351	0	0	53,650	0	*	115,006
Study Area	2,808,075	5,847	0	2,910,283	8,608	0	5,732,813
Amhara Region	5,250,765	19,142	3,483	5,206,338	24,930	8,118	10,512,777

1/: Represented by figures of Kalu where Aregoba territory was involved.

Source: Ethiopian Agricultural Sample Enumeration, 2001/02, Results for Amhara Region, CACC

3.3.5 Agricultural Research Centers

After the establishment of Amhara Regional Agricultural Research Institute (ARARI) in August 2000, the agricultural research centers in the region have been reorganized by incorporating the livestock multiplication centers under the research network of ARARI. Currently, there are 8 research centers operated in the region under the coordination of ARARI.

Table 3.3.21 Research Centers in Amhara Region (2008)

Research Center	Target Zone/Area	Major Research Fields/Commodities
ARARI	Region	Coordination of Centers, tissue culture
Adet	East & West Gojam, South Gondar	Cereals, pulses, oilseeds, root crops, vegetables, natural resources
Gondar	North Gondar (new center)	Crop, livestock, natural resources
Sirinka	North Eastern part of ANRS	Sorghum, teff, lowland pulses, livestock & natural resources
Andassa	Regional (livestock center)	Poultry, cattle, forage
Debre Birhan	North Showa	National coordinator on sheep; crop, livestock & natural resources
Mechanization	Regional center	Agricultural implements & machinery
Sekota	Sekota area (North Wollo)	Livestock, crop, natural resources
Fishery	Regional center	Fishery

Source: ARARI

Among them, the centers covering and located in the eastern part of the region (the Study Area) are Adet, Shrink and Sekota Agricultural Research Center (ARC). The main mandate of Adet ARC and Sirinka ARC is the improvement of temporary crops production. Sekota ARC is rather specialized in livestock production improvement, especially in small ruminants.

The primary constraints faced by the ARCs are reported to be financial problems and poorly equipped research instruments and facilities. However, the limited linkage of research, extension & farmer might be the most serious problem encountered by the regional research-extension systems.

3.3.6 Agricultural Extension Services

(1) General

Agricultural extension services in Ethiopia were traditionally provided by the public sector under a top-down approach. However, following the adoption of Training and Visit Strategy of Extension by the World Bank in 1984, the Participatory Demonstration & Extension Project (PADEP) was adopted as an extension system in the country. Further, since 1995, the country has been undertaking a home

grown development strategy known as, Agricultural Development Led Industrialization (ADLI). One of the main facets of this strategy in the agricultural sector has been the generation, adoption and diffusion of new farm technologies in the form of new and improved inputs and practices. In the mobilization of small farmers and the dissemination of better farming practices, the agricultural development strategy has been promoted through the Participatory Demonstration & Extension Training System (PADETS) by replacing the PADEP, in which a bottom-up approach is emphasized and institutionalized. The PADETS strategies contain:

- Sizable demonstration plots in farmers fields instead of fenced government plots,
- Provision of input credit under local government credit guarantee arrangement,
- Market led inputs & output prices, and
- Institutional linkages with rural development committees.

Its stated objectives include: i) increased incomes and level of living, ii) fostering food security and improved health, iii) free organization by sex, age and lines of occupation, iv) provision of raw materials for industry, v) enhancement of foreign exchange, and vi) conservation of natural resources and environment all through the provision of appropriate technologies and the participation of women.

(2) Extension System and Institutions

Under the decentralization policy in the country, the provision of extension services has largely been devolved to the Woreda level agricultural agency, Woreda Agriculture and Rural Development Office (WAO), and extension agents of the Office, Development Agents (DAs). The current extension system employed in Ethiopia is composed of three tiers of government administrative structures (federal, region, Woreda) and involves MoARD, BoARD & Zonal Agriculture & Rural Development Office (ZAO) and WAO including DA and Farmer Training Center (FTC). Major functions of the extension agencies at the federal, regional and Woreda levels are as follows.

Table 3.3.22 Extension System, Extension Staff & Facility in ANRS (2008)

Institution/Staff/Facility	Function/Deployment
MoARD (federal)	Policy/strategy formulation
	Technical guidance to regional state agricultural offices
	Procurement & introduction of new technologies
BoARD (region)	Policy/strategy formulation & planning
	Formulation of extension & technical packages
	Development & dissemination of indigenous technologies from farmers
	Technical guidance to WAOs
ZAO (zone)	Linkage between BoARD & WAOs
	Technical guidance to Woreda agricultural offices
	Monitoring & supervision of Woreda activities
WAO (Woreda)	Implementing agency of extension services
	Implementation, monitoring & supervision of extension activities
	Technical guidance to DAs
DA (Woreda/Kebele)	Kebele level extension agent
	Planning, implementation & monitoring of extension activities
	Technical guidance to farmers
	Deployment 3DAs per 1,000 ~ 2,000 household or per Kebele
	Deployment of DAs in ANRS: 10,870 (in 2008)
FTC (Woreda/Kebele)	Grass-root contact center having an important bearing on extension activities

	Farmer training facility & office of DAs established in each Kebele
	Facilities: DA office, class & exhibition room, demonstration. field 2.5 ~ 3.0ha
	No. of FTCs in ANR: 2,233 (in 2008)
Veterinary Center	1 center per 3 Kebeles (target)
Other Field Staff (Woreda/Kebele)	DA Super visor: 1 per 3 FTCs
	Cooperatives Officer: 1 per 3 FTCs
	Veterinary Technical: 1 per 3 FTCs

The recruitment and intensive deployment of the DAs at Kebele level has been strongly promoted and the 2-year education of the DAs is being carried out at college level schools established under the Agricultural Technical & Vocational Education Training (ATVET) Program including 1 year of field practical training. In ANRS, there established 5 ATVET schools (2008).

(3) Institutions Involved in Extension Services

The institutions involved in the agricultural extension services include the government institutions as stated earlier, donor agencies and NGOs. BoARD is the agency responsible for the execution of extension services and technology development as a central institution in ANRS. The reorganization of the Bureau was carried and the new Bureau composed of ten Processes: namely Agricultural Extension; Natural Resources Management, Irrigation Development, Agricultural Input Supply & Distribution; Agricultural Products Marketing; Livestock & Plant Quarantine, Planning and Information & Technology Promotion, Protection and two administrative processes headed by process owners (as of December 2010).

ZAO is rather weakly established as a linkage institution between BoARD and WAOs. WAO and its Kebele level field staff are actual players of the agricultural extension services to farming communities. The organization structures of the target 8 Woredas are as shown in the following table.

Table 3.3.23 Organization Set-up of WAOs

as of June 2010

Process		Woreda							
		Ebinate	Simada	Bugena	Gidan	Kobo	Mekedela	Legambo	Aregoba
Organization Set-up									
Extension		O	O	O	O	O	O	O	O
N.R. Management		O	O	O	O	O	O	O	O
Irrigation		O	O	O	O	O	O	O	O
Input Supply		O	O	O	O	O	O	O	O
Cooperatives		O	O	O	O	O	O	O	O
Food Security		O	O	O	O	O	O	O	O
Early Warning		O	O	O	O	O	O	O	O
Quarantine		O	O	O	O	O			
Rural Energy		O			O		O	O	
Mining		O			O	O	O	O	O
Planning & Programming		O	O	O	O	O	O	O	
Civil Services		O		O	O	O	O		
Auditing		O	O	O	O	O	O	O	O
Others		1	1		1		1		1
Total (No. of processes)		14	12	11	14	12	13	11	10
Staffing									
Staff No.	Technical	67	52	31	63	56	70	65	30
	Others	13	13	8	12	20	10	32	5
	Total	80	65	39	75	76	80	97	35
No. Kebeles		37	40	13	26	35	29	35	7
No. FTC		28	39	13	25	30	28	31	3
No. of DAs		60	105	31	95	119	95	83	19
No. of Supervisors		9	9	4	8	11	6	10	1

1/: O - process formed in WAO

International and bilateral cooperation organizations involved in watershed management in ANRS are providing agricultural extension services. Major such organizations include GTZ, SIDA, CIDA, WFP

and FAO. The primary NGO providing the extension services is ORDA.

(4) Extension Activities

The PADETS approach emphasizes the development and dissemination of extension packages to farmers. As of 2008, 92 packages had been developed in ANRS consisting of 53 packages for crop sub-sector, 26 for livestock sub-sector, 6 for host-harvest sub-sector and 7 for in natural resources sub-sector. In case of crop sub-sector packages, the packages generally cover supply of seed and fertilizer, provision of credit, training of participating farmers and demonstration plots. Through this approach, DAs encourage the use of packages tied to credit and they are deeply involved in the distribution of inputs and the collection of credit repayments. This package-driven extension approach has been implemented on a large scale in the country and in ANRS. The extension packages are accommodated in the 2008 BoARD annual plan as indicated below.

Table 3.3.24 Extension Packages Planned in 2008 in ANRS

Extension Packages	No. Farm Participating Households
Minimum Package	2,869,334 households
Household Package	330,666 households 1/
Total	2,902,400 households

1/: Households being in package Source: BoARD

Since the launching of PADETS in 1995, the dissemination of Extension Package Programs (EPP) covering technology packages of crop, livestock and natural resources sub-sectors has become the main stay of agricultural extension activities by the WAOs and DAs. However, the EPP has currently been rearranged and categorized into Household Package and Minimum Package. The Household Package intends to attain target income of household of 10 Birr/day/family in a period of 3 years. The objective of Minimum Package is productivity improvement & production increase. Household Package is for 3 years and combinations of plural technology packages are adopted to attain the target income based on a baseline survey of individual households with the DAs' support. Minimum Package is for a period of 1 year and targeted for a group of 10 farmers (1 model farm & 9 member farmers). In both Packages, training and technical guidance by the DAs are to be provided to target groups. The features of the Packages are as follows;

Table 3.3.25 Household & Minimum Packages

Extension Packages	Objective	Period	Technology Packages	Credit
Household Package	Livelihood improvement	3 years	Plural packages	Institutionalized
Minimum Package	Production	1 year	1 package	Institutionalized

The extension packages implemented in the target Woredas in 2007/8 are reported as follows;

Table 3.3.26 Extension Packages Implemented in the 8 Woredas (2007/8)

Cooperatives	Bugena	Gidan	Kobo	Ebinate	Simada	Aregoba	Legambo	Mekedela
Household Package								
- Annual Plan	1,170	3,268	4,650	5,782	10,360	1,000	1,913	n.a.
- Performance	119	1,615	3,600	n.a.	5,712	300	n.a.	n.a.
Minimum Package								
- Annual Plan	13,500	17,850	44,236	41,930	49,144	500	20,400	n.a.
- Performance	2,677	1,769	30,432	n.a.	37,658	420	n.a.	n.a.

Note: Annual performance for Ebinate & Aregoba at end of 3rd quarter; other Woredas at end of 4th quarter
Source:2007/8 Annual Performance Report of WAOs

(5) Assessment of Extension Packages by Farmers

In the Socio-economic Survey Report conducted by MoARD in 2003 and by BoFED in 2004, comprehensive assessments of the extension technology packages by farmers in the 8 target Woredas were reported. Major findings of the assessments are enumerated as follows.

- Main source of information on technology packages is DA followed by fellow farmers.
- Majority of farmers reported usefulness of technology packages, however, negative responses are reported in Mekedela Woreda.
- Reasons for discontinuing participation in extension packages differ among the 8 target Woredas, however, main ones include: i) higher cost of packages, ii) poor results of packages, and iii) natural hazards encountered.
- Main reason for not participating in extension packages is limited capacity for introducing extension packages.
- Main factor contributing to adoption of crop package is better extension advice.
- Main factor contributing to adoption of livestock package is better extension advice followed by easiness to apply.
- Main reason for not applying DA advice is that farmers could not understand the advice.
- Farmers preference on crop packages is cereal (teff & wheat).
- Government supports sought by farmers are credit for input, adequate training and assigning of qualified DA.

(6) Weaknesses in Current Extension Services

The current extension system in Ethiopia envisages intensive deployment of extension staff at Kebele level and introduction of comprehensive extension packages under credit arrangement. However, the system appears to involve weaknesses inherent in it as commented by IFPRI[14] as follows.

- Seed-fertilizer technology packages of crop sub-sector are not very appropriate in heterogeneous rainfed areas, especially when they are tied to credit conditions. Rather, smallholders need access to flexible and divisible technologies combined with the capacity to select and adopt practices appropriate to their particular field and seasonal conditions.
- Because of standardized package approach and inflexible input distribution system, farmers have little opportunity to experiment, learn and adopt technologies to their own needs.
- Although many farmers seem to have adopted the extension packages backed by credit programs, a number of them had discontinued its use (EDRI[15]). Poor extension services were ranked as the top reason for non-adoption.
- Broad range of demand-responsive extension & participatory research, innovation adaptation and demonstration activities envisaged in the extension system centered in FTC are seldom realized as DAs are preoccupied with the distribution of inputs and recovery of credit and

[14] Policy to Promote Cereal Intensification in Ethiopia: A Review of Evidence and Experience, IFPRI, 2007
[15] Agricultural Extension, Adoption and Diffusion in Ethiopia, EDRI, 2004

most of them have rather limited experiences. This invites questions whether sufficient human resources and expertise exist to make FTCs functional.

- Capabilities and experiences of DAs are rather limited in many cases because of rapid deployment of newly recruited college graduates to fields.
- The extension system remains under pressure to meet certain targets. The hierarchical "culture" underlying the extension system does little to encourage and exploit the inherent resourcefulness of those who work closely with farming communities.
- Farming communities in many cases do not participate in extension planning and DAs remain largely conveyors of technical messages, rather than active facilitators of community capacity building and providers of relevant information.
- Limited accessibility at a region level to physical and financial progress of the implementation of extension packages at field level indicates the poor performance of monitoring & evaluation system on the packages.

3.3.7 Seed Production and Distribution

(1) Seed Production and Distribution System[16]

The establishment of Ethiopia's formal seed system started when the National Seed Council (NSC) was set up in 1976 to formulate recommendations for seed production and supply of released varieties from the national research programs and the establishment of Ethiopian Seed Corporation in 1979 to undertake seed production, processing, distribution and quality control in the country.

The current formal seed supply system in Ethiopia is illustrated in the following figure, which works mainly for major cereal and pulse crops like maize, wheat, teff and beans.

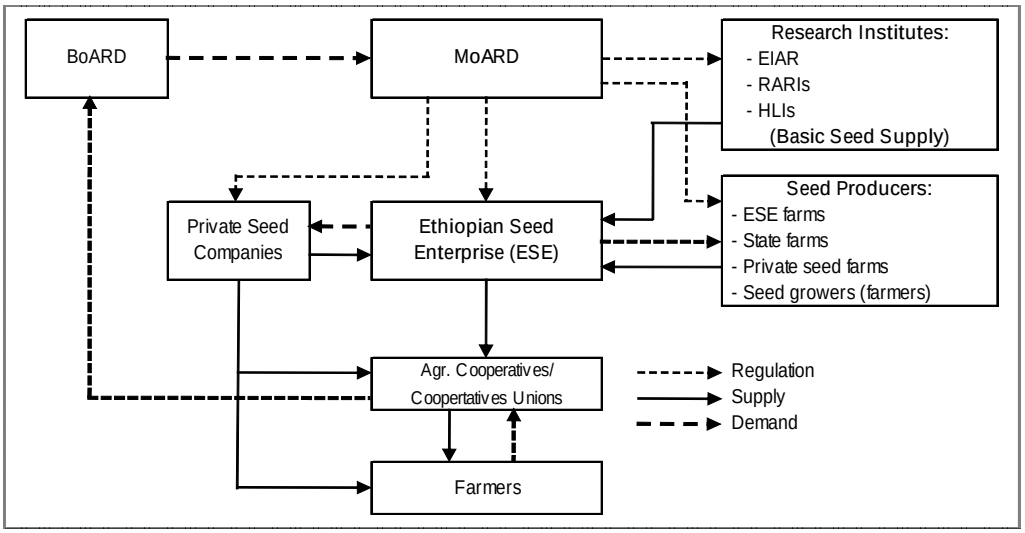


Figure 3.3.1 Formal Seed Production & Supply System in Ethiopia

Production of quality seeds in the country is limited to major cereals, which indicates that there is large potential for the seed industries to expand their business to other crops. Even though the participation of the private sector is increasing in seed production, their role in the marketing and

[16] This section was prepared based on "The Ethiopian Seed System", Dawit Alemu et al, IFPRI, 2006

distribution directly to end-users is limited. Following the early 90s market reform, the participation of private sector has increased in both seed production and distribution even though the role of the public sector is still dominant.

(2) Seed Producers

The main institutions involved in seed production include Ethiopian Seed Enterprise (ESE), State Farms, private farms, NGOs, cooperatives & cooperative unions and seed growers (small-scale farmers). ESE dominates the formal seed market and manages the production, marketing and distribution of improved cultivars nationwide. ESE is the only public seed enterprise responsible for production of seed for all crops (cereals, pulses, fruits, vegetables and forage), although its seed production is dominated by cereals, especially maize and wheat.

The supply of breeder and basic seeds is the responsibility of those research centers, primarily EIAR and the regional agricultural research institutes (RARIs), who develop varieties and are registered as their maintainers.

(3) Seed Inspection and Certification

General procedures for seed certification begin with verification of the source of the basic seeds to be used for production of certified seeds, followed by verification of germination rates, grading, and other functions to assure quality. However, there are cases, particularly in times of seed shortages, where produced seeds were certified without following the necessary procedures.

The seed inspection and certification of annual crops in ANRS is carried out by BoARD through the five Plant Seed Laboratories established in the strategic places in the region. Under the system, the field inspection by the experts of Laboratories is carried out twice in a cropping season (flowering & maturing stage). The seed certification is performed by the Laboratories through the laboratory test and the basic criteria for certification are germination rate (above 85%) and purity (98%).

(4) National Demand and Supply of Seed

For the 2005 production season, the supply of seed in aggregate was only 27% of the total seed demands. However, there was considerable variability in the level of supply among the different crops, where more than 50% of the demanded volume of seed was supplied for maize and chick pea.

Table 3.3.27 National Seed Demand and Supply in 2005 (ton)

Crop	Demand	Actual Supply	Sufficiency
Maize	15,522	8,246	53%
Barley	7,084	1,163	16%
Wheat	51,849	10,628	20%
Teff	7,839	420	5%
Faba Bean	7,773	476	6%
Chickpea	4819	2,641	55%
Haricot bean	3,374	703	21%
Sesame	2,177	605	28%
Grand Total 1/	111,759	30,404	27%

1/ Including other crops Original Source: Agricultural Inputs Marketing Department, MoARD

(5) Seed Demand and Distribution in ANRS

The formal seed production and distribution system in ANRS is similar to that of national and the

seeds produced by the producers are usually distributed through agricultural cooperatives and cooperatives unions to farming communities. Major producers supplying seeds to the region include the public enterprises of ESE and Bale Agricultural Development Enterprise and a private Pioneer Hybrid P.L.C. The predominant supplier is the public enterprises and, for the formal seed supply in the 2008 cropping, nearly 90% of total supply was covered by the public enterprises. The gaps between the forecasted demand and actual supply in 2006/07 in the region are as follows.

Table 3.3.28 Seed Demand and Supply in 2006/07 in ANRS (ton)

Crop	Demand	Actual Supply	Distribution	Sufficiency 1/
Maize	8,055	3,435	3,198	43%
Barley	466	107	98	23%
Wheat	5,836	2,443	1,835	42%
Teff	506	142	136	28%
Haricot Beans	278	58	46	21%
Others	1,133	694	557	61%
Total	16,274	6,879	5,870	42%

1/: Actual supply/demand x 100 Source: BoARD

The primary constraints in the seed production and distribution in ANRS are: i) large gaps between requirements/demands for quality seeds and supply of them, ii) price differences among suppliers (public & private), and iii) quality seed prices beyond capability of most farmers.

3.3.8 Farm Input Supply

Farm inputs supply to farming communities is under the regulation of the government in Ethiopia. The government intervention in farm inputs supply includes: i) forecasting of demand for inputs from Kebele level up to region and federal level, ii) procurement of inputs from suppliers through tendering process, and iii) distribution of inputs to Kebele level through channel of suppliers.

Accordingly, farm inputs supply such as fertilizers, agro-chemicals and livestock inputs (such as animal feed) in the country is largely under the hand of public enterprises, while some agricultural cooperatives unions are also involved in such services. The public enterprises for farm inputs supply include Agricultural Input Supply Corporation (AISCO) for fertilizer and agro-chemical supply. The fertilizer demand forecasting and supply system in ANRS is illustrated as follows.

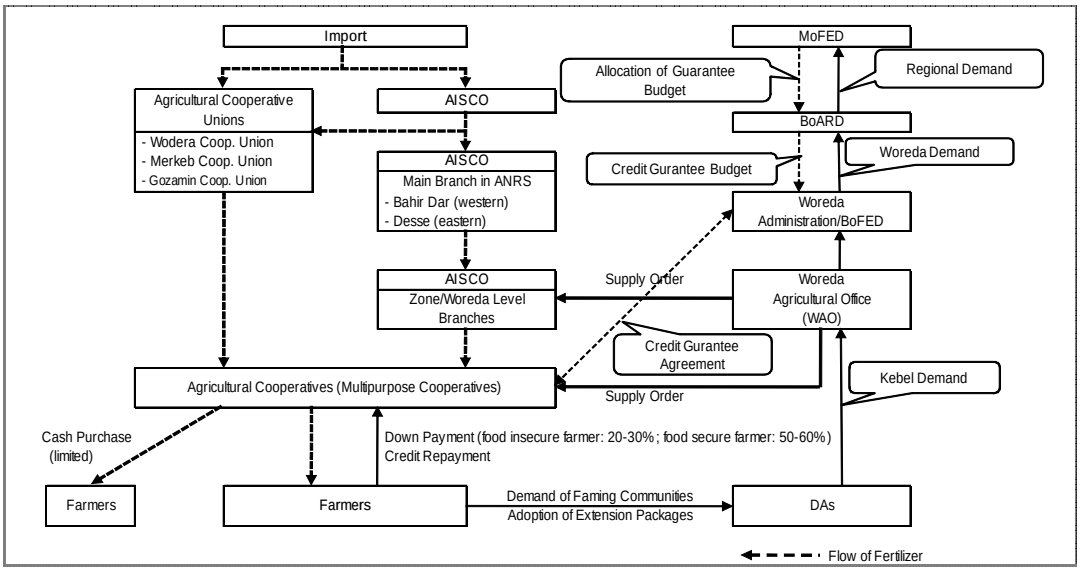


Figure 3.3.2 Fertilizer Supply System in ANRS

Fertilizer supply in the region and country is carried out under the credit arrangement accommodated in the extension services of provision of extension packages. The credit term for crop extension package is interest rate of 18% in case of AISCO and loan period of 6 months (1 cropping season). The down payment required is 20~30% of credit amount for food insecure households and 50~60% for food secured households. Major constraints in fertilizer supply in the region are reported to be: i) higher price than affordable by farmers & current price increase, ii) supply not in time, and iii) shortage of supply.

3.3.9 Marketing

(1) General

Agricultural production in ANRS is predominantly performed by smallholders largely under rainfed condition and yield levels are low and highly variable from year to year. Due to the dominance of rain-fed agricultural production, the market depends primarily on the major harvest season that occurs from November through December (meher season harvests). In this period prices are at their lowest given the large supply that floods the market as farmers seek to sell in order to meet financial obligations related to various expenses of social as well as legal nature. Low grain prices immediately after harvest and in “good years” and year-to-year price fluctuation are discouraging investments in inputs such as fertilizers and improved seeds. The volume of grain marketed falls sharply in years of poor harvest and price rises considerably. On the other hand, prices are seriously depressed in “good years”. Marketing uncertainty, faced especially by small holders, dampens production incentives and contributes to stagnation in agricultural output and productivity, and thereby distracting improvement in rural livelihood. On the other hand, high food price variability makes poor consumers in urban and food deficit producing rural areas more prone to food insecurity.

Major agricultural commodities marketed in the region include cereals (teff, barely, wheat, maize and sorghum), live animals and oil seeds. However, marketed products do not represent actual surplus products and products sold in the form of forced selling, forced to sell parts of his products to pay rents & bets, buy inputs & non-farm staples and cover other immediate expenses.

Further, the primary reason for selling livestock is to generate income to meet unforeseen expenses, although sales of live animals is taken as a last resort. This is apparent when crop failure due to drought is encountered. Farmers sell their livestock to buy food grains for domestic consumption. Usually, small ruminants are sold to cope with food insecurity during drought and large ruminants are generally sold when they are old.

(2) Marketing Channel

Marketing channels of agricultural commodities are diversified in the region. However, the predominant marketing channels of major crops are reported to be almost the same and major players in marketing include farmers (producers), assemblers, primary cooperatives, secondary cooperatives

(union), EGTE, wholesalers, retailers and consumers as illustrated below[17].

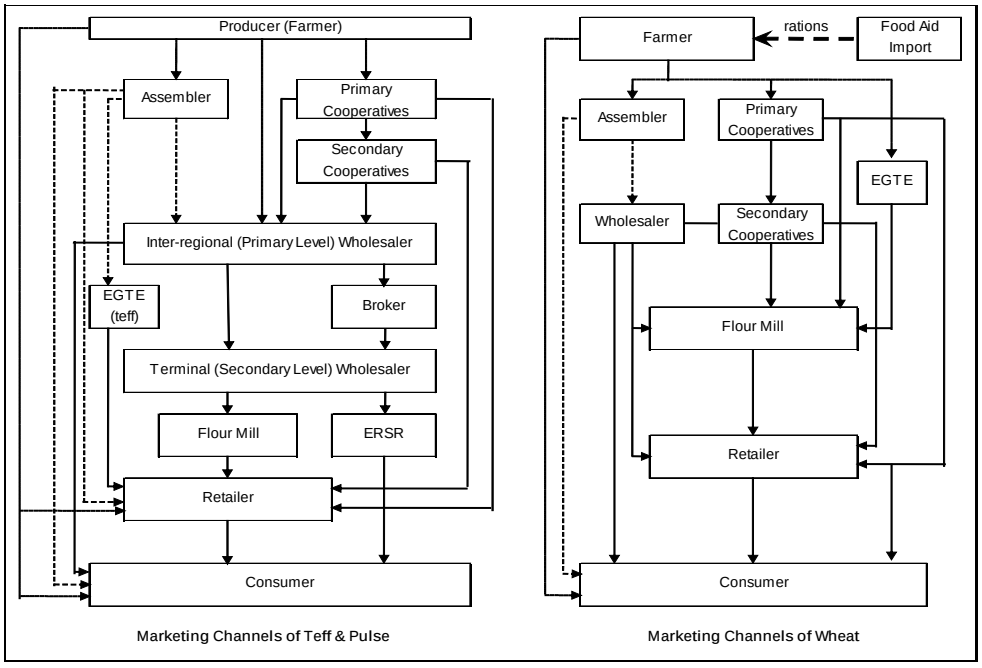


Figure 3.3.3 Marketing Channels of Cereals in ANRS

The prevailing marketing channel of sheep/goat and fattened animal are: farmers – assembler (at animal markets/Kebele & Woreda markets – wholesaler/retailer. Animal markets are usually opened on Saturday in the target Woredas.

(3) Prevailing Marketing Channel in the 8 Target Woredas

The prevailing marketing channels of farm products in the 8 target Woredas are basically similar in all the Woredas as described in the following table.

Table 3.3.29 Prevailing Marketing Channels in the 8 Woredas

Woreda	Cereals	Pulses	Vegetables	Animal
Ebinate	F - assembler	F - wholesaler - retailer	F - R	F - R
Simada	F - R	F - assembler - wholesaler - R	F - consumer	F - assembler - R
Bugena	F - assembler - R/F - R	F - assembler - retailer/farmer - R	F - R	F - assembler & F - F
Gidan	F - assembler - wholesaler - R	F - assembler - wholesaler - R	F - assembler - wholesaler - R	F - wholesaler - R/F - consumer
Kobo	F - assembler - R/F - R	F - assembler - retailer/farmer - R	F - R	F - R
Mekedela	F - local assembler - assembler - wholesaler	F - assembler - wholesaler - R	F - assembler - wholesaler - R	F - assembler - wholesaler - R
Legambo	F - wholesaler - R	F - wholesaler - retailer	F - R	F - R
Aregoba	F - assembler	F - assembler	F - assembler	F - assembler - wholesaler - R

F: farmer, R: retailer

Source: Interview Survey with WAO by JICA Study Team

(4) Problems and Constraints for Marketing

Major problems/constraints for marketing of farm products in the 8 target Woredas are as follows.

- Limited physical accessibility to markets is a common marketing constraint of the 8 target Woredas. Bugena and Aregoba are remotely located and Kobo is rather favorably located in terms of traffic condition.

[17] Source: Agricultural Commodity Marketing System Study Project, ANRS Head of Gov. Office, 2004

- Farming activities in the 8 target Woredas are mostly practiced under subsistence level and production surplus for marketing is limited, resulting in lack of bargaining power. Market oriented agriculture production is yet to be envisaged.
- Due to the dominance of rain-fed agricultural production, market depends primarily on the major harvest season from November to December. In this period when farmers seek to sell products in order to meet financial obligations, prices are at their lowest.
- Rural traders are undercapitalized and have very limited capacity to absorb production surplus, leading to depression of farm gate prices, especially in the harvesting season.
- Small-scale producers have been shouldering the burden of seasonal price variability. The establishment of marketing cooperatives could serve as multipurpose vehicles for rural development. However, agricultural cooperatives established in the Woredas are still weak.

3.3.10 Agricultural Cooperatives

(1) Agricultural Cooperatives in ANRS

In ANRS, 3,861 primary cooperatives and 33 secondary cooperatives existed as of 2007. The numbers of primary cooperatives by type are shown in the following table.

Table 3.3.30 Inventory on Primary Cooperatives in ANRS (2007)

Cooperatives	No.	Membership		Capital (1,000 Birr)	
		Total	Per Coop.	Total	Per Coop.
Agricultural Cooperatives	2,032	1,804,518	888	138,788	68
- Multipurpose	1,707	1,778,960	1,042	122,498	72
- Dairy	82	2,698	33	954	12
- Irrigation	166	13,497	81	9,498	57
- Apiculture	24	5,398	225	802	33
- Fattening	32	1,402	44	687	21
- Others	21	2,563	122	4,349	207
Saving & Credit	476	37,086	78	3,179	7
Other Cooperatives	1,353	39,452	29	20,104	15
Total	3,861	1,881,056	487	162,071	42

Source: ANRS Cooperatives Promotion Agency

The total membership of the primary cooperatives is 1,881 thousand and the average membership per cooperative stands at 487. The participation rate of farmers in agricultural cooperatives is roughly estimated at around 50%. The financial status of cooperatives is still at an infant level and the amount of capital per cooperatives is limited to 42,000 Birr.

The most important cooperatives in the region are agricultural cooperatives and in total of 2,032 primary cooperatives are formed, about 53% of all cooperatives. The total membership of the agricultural cooperatives is 1,805 thousand and the average membership per cooperative stands at 888. However, the financial status of the cooperatives is still at an infant level and the capital per cooperative is limited to 68,000 Birr.

The most important agricultural cooperative is multipurpose cooperatives accounting for 84% in number and 99% in membership of all the agricultural cooperatives. The total membership of the cooperatives is 1,778 thousand (99% of all membership of agricultural cooperatives) and the average

membership per cooperative is 1,042. The capital per the multipurpose cooperatives is limited to 72,000 Birr and their financial status is still at a preliminary level.

Major service activities of the multipurpose cooperatives include: i) farm input supply, ii) provision of credit for the extension packages, iii) marketing of farm products, and iv) supply of consumer goods. The typical organization structure of multiple cooperatives is shown in the following figure.

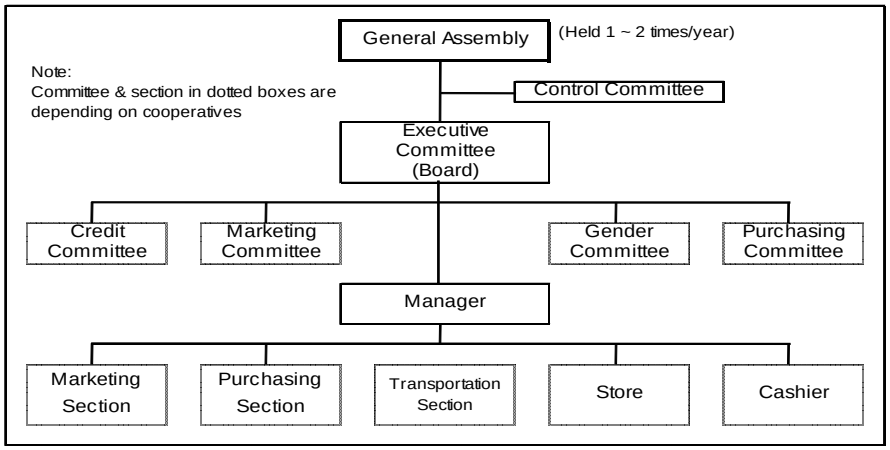


Figure 3.3.4 Typical Organization Set-up of Multiple Cooperatives

There are 33 unions (secondary cooperatives) in ANRS: 24 multipurpose unions, 6 saving & credit unions, 2 dairy unions and 1 apiculture union as follows.

Table 3.3.31 Inventory on Unions (Secondary Cooperatives) in ANRS (2009)

Union	No.	Membership (cooperatives)		Capital (1,000 Birr)	
		Total	Per Coop.	Total	Per Coop.
Agricultural Coop. Union	27	550	20	35,602	1,319
- Multipurpose	24	532	22	35,269	1,470
- Dairy	2	10	5	193	97
- Apiculture	1	8	8	140	140
Saving & Credit Coop. Union	6	141	24	1,873	312
Total	33	691	21	37,475	1,136

Source: ANRS Cooperatives Promotion Agency

The total number of multipurpose cooperatives participated in the unions is 532 or 31% of all the multipurpose cooperatives in ANRS. The average number of member cooperatives per union is 22. The financial statuses of the unions are still weak similar to the primary cooperative and the average of capital of the multipurpose union is limited at 1.5 million Birr. All the agricultural cooperatives Unions are established at Bahir Dar.

The major activities of the multipurpose union are: i) supply of farm inputs to member cooperatives and members/non-members, ii) collection & marketing of farm products, iii) provision of credit to member cooperatives, iv) transport & storage services, procurement & supply of consumer goods to primary cooperatives, and v) provision of market & technical information.

It is said that farming communities have unfavorable impressions toward cooperative activities because of the bitter experiences of Peasant Association under the socialist regime. The constraints or weaknesses in the agricultural cooperatives sector are enumerated as follows.

- Low participation rate of farming communities
- Poor financial status
- Insufficient managerial capability of members
- Limited marketing surplus of farm products in service areas

(2) Agricultural Cooperatives in the 8 Woredas

The inventory on primary cooperatives in the 8 target Woredas are shown in the following table.

Table 3.3.32 Inventory on Primary Cooperatives in the 8 Woredas (2009)

Cooperatives	Ebinate	Simada	Bugena	Gidan	Kobo	Mekedela	Legambo	Aregoba
Agr. Cooperatives								
- Multipurpose	29	15	11	17	12	17	14	3
- Irrigation	7				7	4	9	
- Apiculture						1	1	
- Fattening						1	1	
Saving & Credit	5			5		4	3	
Other Cooperatives	3	1				1	1	
Total	44	16	11	22	19	28	29	3

Source: ANRS Cooperatives Promotion Agency

The cooperatives having good performance in the Woredas are reported by the Cooperatives Promotion Agency as: multipurpose cooperatives in Bugena, Gidan, Kobo, Ebinate, Simada, Legambo and Mekedela and irrigation cooperatives in Kobo, Ebinate, Legambo and Mekedela.

3.3.11 Proposed Approaches for Agricultural Promotion

(1) Problems/Constraints for Agricultural Promotion

Major problems and constraints for agricultural promotion in the food insecure Woredas were identified under the Study through: i) the series of workshops held in the target Woredas, ii) discussion and interviews with WAOs/DAs/target watershed communities, iii) information provided by BoARD/WAOs, iv) field visits to the watersheds, and iv) statistic data and related research papers and also through the implementation of verification activities for agricultural promotion under the Verification Project of the Study in the 8 food insecure Woredas (Ebinate, Simada, Bugena, Gidan, Kobo, Mekedela, Legambo and Aregoba). For the agricultural promotion, such problems and constraints should better be addressed in an integrated manner. In the Study, these problems & constraints have been analyzed by categorizing them into: i) agronomic & agro-economic issues, ii) livestock issues, iii) extension services, and iv) marketing issues as discussed in the followings.

1) Agronomic and Agro-economic Issues

The captioned issues are of the primary importance for agricultural promotion in the 8 target Woredas and the basic agronomic constraint is the unstable and low productivity of temporary crops adversely affected by various factors. Major problems or constraints and proposed development directions to be taken are discussed as follows;

- One of the primary constraints attributed to the unstable and low crop productivity is cultivation of crops by employing traditional and subsistence farming practices under rainfed conditions of unstable rainfall distribution.

These constraints should be addressed through the improvement of current farming practices to the extent of possible support by the strengthening of extension services.

- Another primary constraint, which is endangering the sustainability of crop production, is the distribution of degraded soils attributed to the past and ongoing erosion and improper soil management under traditional farming activities. Most of the soils distributed in the highland areas of Amhara Region have shallow effective depth of less than 50cm and most of the lands in the areas are classified into erosion hazard classes of “high to very high” according to an erosion hazard classification study.

  These constraints should be addressed through the introduction of improved farming practices integrated with soil & water management & both physical and agronomical (biological/vegetative) conservation measures supported by the strengthening of extension services as stated earlier.

- Another problem attributed to the unstable and low productivity of secondary crops might be cultivation of too many crops by individual farmers. This is because farmers grow or at least attempt to produce a wide range of crops for their survival and in search of food security.

  It will be necessary, by paying due consideration to subsistence requirement of crops, to encourage farmers to concentrate on crops that environmental conditions are suitable for their lands. Activities toward this direction might include the introduction of new crops with sufficient potential to a subject area. The introduction of new or less common crops including fruits had been requested by WAOs/DAs/farmers in the series of discussions held with them under the Study. The adaptability and potential of such crops should be tested.

- Agronomic elements attributed to the unstable and low productivity of crops are crucial and they include physiographic conditions less suitable for temporary crops, limited and unstable rainfall, low temperature, frost & hail in high altitude areas, poor soil conditions, cultivation of crops/varieties less adapted to subject areas, cultivation of self-multiplied seeds of poor quality, lack of soil fertility management and pest & disease. Some of these constraints should be addressed within the context of the improvement of farming practices to an extent possible.

- Another important agronomic problem is the scarcity of water resources. However, development of water resources for agriculture to an extent possible and efficient use of limited water resources should better be envisaged.

- Other important issues are limited land holding size and poor financial status of farm households. Parts of such constraints should be addressed in a manner currently employed by BoARD (provision of household packages) and income generation activities.

2) Livestock Issues

The livestock sub-sector is another important economic activity of farm households in the highland areas. In addition, draft cattle are primary sources of labor for land preparation and transport of farm

inputs/products. However, livestock husbandry in the areas is still less intensive and the sub-sector faces unstable and low productivity. Cattle are generally stocked as assets and small ruminants are usually to cope with food insecurity. Major constraints for livestock sub-sector production promotion include problems in feed supply, animal health, husbandry practices, and genetic resources as follows.

- Livestock husbandry practices depending on crop residues and poor grazing ground and shortage of livestock feed resources are reported to be a primary common constraint.

  Approaches to increase production of forage in an integrated manner with soil & water conservation activities are essential to mitigate the constraint in land available for the purpose, such as communal land, hillside, farm boundary, home yard and other land resources less utilized or unutilized.

- Another primary constraint reported is animal/poultry losses caused by diseases due to insufficient veterinary services coverage.

  This is to be addressed through strengthening of animal health services through the activation of existing veterinary service centers or other measures to improve veterinary services at a Kebele level.

- Another important constraint attributable to low productivity is poor genetic resources of animals, especially cattle, which is to be addressed through the strengthening of genetic resources improvement activities.

- Traditional livestock husbandry puts emphasis on number of stocks rather than productivity, which is prevailing in the highland areas. This should be addressed through the introduction of improved husbandry practices as currently envisioned in the livestock extension packages.

3) Extension Services

Major constraints/problems on the current extension services discussed are enumerated as follows;

- Seed-fertilizer technology packages of crop sub-sector are not very appropriate in heterogeneous highland areas. Farmers need access to technologies appropriate to their particular fields and seasonal & financial conditions. Because of standardized packages, farmers have little chances to experiment, learn and adopt technologies to their own needs.
- Poor extension services might be ranked as an important reason for non-adoption or discontinuation of extension packages.
- Extension system centered in FTC is seldom realized because DAs are preoccupied with the burden of extension package promotion and other non-extension mandate.
- Capabilities and practical experiences of DAs are rather limited in many cases because of rapid deployment of newly recruited college graduates.
- Practical experiences of Woreda experts are also insufficient in many cases and their capabilities to provide technical guidance to DAs appear to be limited. The empowerment of Woreda experts should seriously be envisaged to train them as commodity-wise specialists

and to improve their capabilities as providers of practical training to DAs.

- The accessibility of Woreda experts or DAs to technical development performances of research centers appears to be very limited. Practically, farming communities have no access to the research performances. The research-extension-farmers linkage has not or poorly been established or institutionalized.
- Farming communities in many cases do not participate in extension planning and DAs remain largely conveyors of technical messages, rather than active facilitators of community capacity building and providers of relevant information.
- Farmers' adoption of new technologies is still limited due to lack of awareness and other various reasons.
- In many cases, DAs reside away from their service areas because of poor living conditions in the areas. Their extension activities in the areas are very limited because of lack of transportation means to the areas.
- The most important human resources in extension services at Kebele level are DAs. While, their statuses appear to be low and they are made light of by regional and zonal staffs. The attitude of regional and zonal staffs to Woreda staffs and DAs should be changed.

The approaches to seek solutions for the said constraints/problems related to the extension services will be: i) introduction of flexible extension packages tailored to needs, capabilities and intensions of farming communities, ii) making use of demonstration, verification and trial fields as central field centers of extension activities, iii) OJT of DAs and WAO staff through the implementation of agricultural promotion activities as carried out under the JICA Study, iv) training of Woreda experts as commodity-wise specialists as cereal, fruit, forage, dairy, seed production, etc., and v) strengthening of research-extension-farmers dialogue through institutionalization of technical support & guidance activities of research centers in agricultural promotion activities as envisioned under the Verification Project of the JICA Study. The approaches for the formulation and implementation of agricultural promotion activities introduced under the Study will be necessary to be taken extensively under the Woreda agricultural development & promotion plan.

4) Marketing Issues

Major common constraints/problems on marketing identified include: i) poor accessibility to market, in terms of both physical access and destination, ii) limited production surplus for marketing, and iii) weakly established cooperatives. A conceivable direction toward the marketing issues will be marketing through cooperatives, provision of marketing information and production promotion of area specific products with sales potential and advantage. Area specific approaches appear to be essential.

(2) Proposed Directions and Approaches for Agricultural Promotion

The proposed development directions and approaches for the integrated agricultural promotion in the Study Area are illustrated by sub-sector (farmland conservation, crop production, livestock production, extension services, marketing & income generation) in Figure 3.3.5.

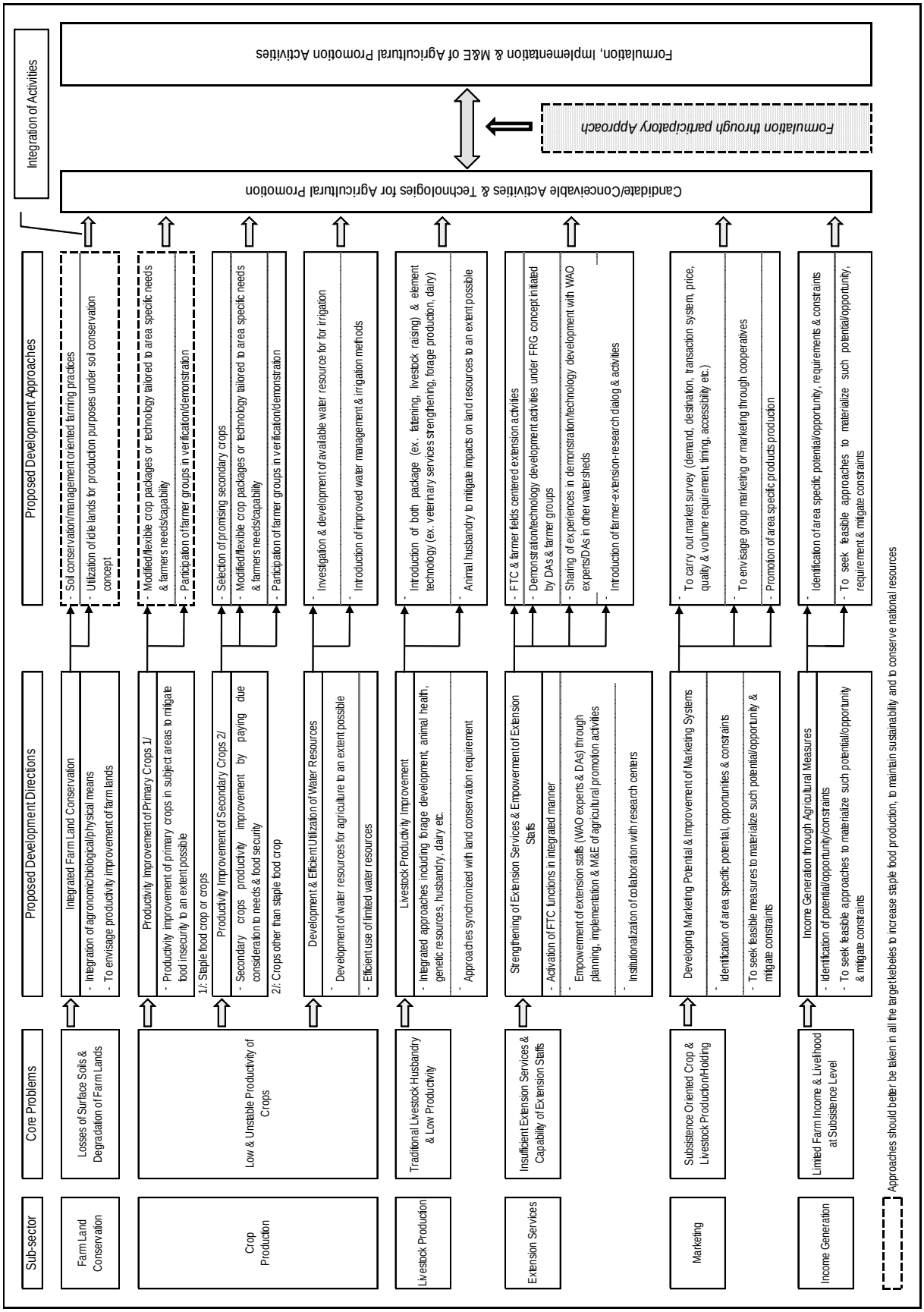


Figure 3.3.5 Proposed Directions/Approaches for Agricultural Promotion in Study Area

The key directions and approaches proposed are as follows.

1) Integrated Farmland Conservation

The integration of agronomic, vegetative and physical measures for farmland conservation and the productivity improvement of farmlands are to be envisaged through soil conservation/management oriented farming practices. For the sustainability of crop production and the conservation of national land resources, this direction and approach should be accommodated in the Woreda agricultural development & promotion plan.

2) Productivity Improvement of Primary Crops

The productivity improvement of primary crops (staple food crops) to mitigate food insecure status is considered to be the most essential agricultural development target of food insecure Woredas and should be accommodated in Woreda agricultural development plans. The proposed approach will be the introduction and extension of modified/flexible crop packages and improved & appropriate farming technologies/practices integrated with farmland conservation measures. The positive participation of farming communities/groups in the promotion and extension of such technologies/ practices should be accommodated in the approach.

3) Productivity Improvement of Secondary Crops

The productivity improvement of secondary crops is another essential issue to improve livelihood of farming communities as crop production is almost exclusively their primary economic activity. It will be necessary, by paying due consideration to subsistence requirement of crops, to encourage farmers to concentrate on crops that environmental conditions are suitable for lands and to optimize the natural productivity of the land. In this approach, the productivity improvement of crops currently grown in the target watersheds and the introduction of promising new crops including fruits is to be envisaged. The proposed approach will be the introduction and extension of modified/flexible crop packages and of improved & appropriate farming technologies/practices integrated with farmland conservation measures like the case for the productivity improvement of primary crops.

4) Development & Efficient Utilization of Water Resources

The availability of water resources for development appears to be limited in the target areas. However, development of water resources for agriculture to an extent possible and efficient use of limited water resources should be envisaged as stated earlier. The proposed approaches will be investigation on development potential of water resources, development of available water resources for irrigation and introduction of improved water management and irrigation methods.

5) Livestock Productivity Improvement

For the improvement of livelihoods of people in the areas, the enhancement of livestock production is considered prerequisite as livestock husbandry is generally the 2nd important (or primary for some farmers) economic activity of them. The direction/approach to be taken will be an integrated approach covering forage development and improvement of animal health, genetic resources,

husbandry and dairy production reflecting area specific requirements and an integrated approach optimizing use of area specific resources & potential. Further, they should be well synchronized with land conservation requirements in the subject areas.

6) Strengthening of Extension Services and Empowerment of Extension Staff

The strengthening of extension services & empowerment of extension staff and the strengthening of farmer-extension-research dialog appear to be essential institutional issues for agricultural promotion. For the purpose, the activation of FTC functions, empowerment of Woreda experts & DAs are to be aimed at through their participation in planning, implementation and monitoring & evaluation of agricultural promotion activities and the institutionalization of collaboration with research institutes for establishing farmer-extension-research linkage.

The proposed approaches for the direction include: i) FTC & farmer fields centered extension activities, ii) demonstration/technology development activities initiated by DAs and farmer groups (under FRG concept), iii) introduction of farmer-extension-research dialog & activities in the planning & implementation of promotion activities, and iv) training Woreda experts as specialists on cereals, pulses, fruit, irrigation agronomy, forage, seed production, cattle, ruminant, poultry, marketing and other subjects.

7) Developing Marketing Potential & Improvement of Marketing Systems

The area specific approach will be essential for tackling marketing issues. The identification of area specific potentials/opportunities & constraints and the study on feasible approaches to materialize such potentials/opportunities and to mitigate constraints should be envisioned. The proposed approaches will be the identification of area specific potentials/opportunities through market survey and promotion of production of area specific products. For the improvement of marketing systems, the approach of group marketing or marketing through cooperatives will be introduced.

8) Income Generation through Agricultural Measures

The primary economic activity in the target areas is agriculture and, in most cases, the livelihood improvement in the areas will have to be attained through agricultural measures. However, land holding sizes of farming communities in the areas are generally limited and rooms for the improvement of livelihood through land based agricultural activities will not be so large. Currently, in the areas, a number of extension packages for income generation have been introduced by BoARD and WAOs. Efforts should be made to introduce agricultural based income generating activities tailored to needs & potential of target Kebeles and farming communities. For the purpose, the identification of area specific needs & potentials will be an initial step.

3.4 Satellite Image Analysis (GIS)

3.4.1 General Approach

The main objective of the remote sensing survey is to determine temporal and spatial distribution of vegetation cover and related condition of soil erosion within the Study Area. This was done by combining filed survey with the remote sensing analysis and GIS analysis for the available recent

years chosen from three decades since 1980s.

The field survey yielded data on land, vegetation, cultivation types, and corresponding land classification used in existing studies (WBISPP, 1986). The survey was made on March to April 2008 and data was subsequently analyzed to derive the actual specific and vegetative cover and land use.

By comparing these factual terrain conditions, remote sensing analysis was conducted for sections and satellite images of different years to obtain the vegetation cover data as well as cultivation and land use types on a multi-temporal basis.

By the combining dataset(s) collected through the field survey, satellite image analysis and other necessary information of soil and meteorology, water balance and soil erosion were calculated together on GIS platform application (SWAT 2005, Soil and Water Resources Tool).

The output of GIS analysis (using SWAT model) includes substantial information to understand the hydrological and soil condition which are composed of area precipitation, evapotranspiration, surface water contribution, soil percolation, groundwater recharge, base flow, groundwater resource, soil erosion and others.

3.4.2 Field Survey

The objective of the filed survey was to provide ground truth for the remote sensing study and to yield first-hand data on vegetation cover and land use type per specific water balance and soil erosion.

Along the two routes including the eight (8) target Woredas, 198 points were totally visited and surveyed for three (3) weeks from the 30th March to 11th April 2008. During the site investigations, the following information was collected as necessary information to verify the land classification with satellite images.

- Co-ordinates of observation points with GPS positioning
- Current Land Classification at points based on WBISPP classification
- Current Land Classification of the surrounding area (100m x 100m) for major coverage based on WBISPP classification
- Current Land Classification of the surrounding area (100m x 100m) for minor coverage based on WBISPP classification

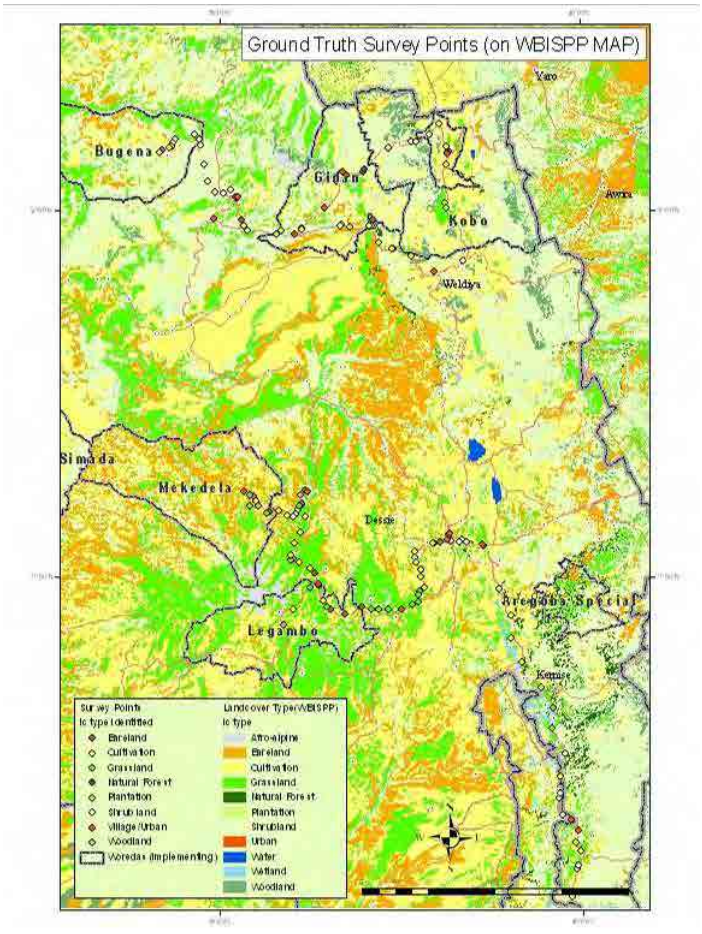


Figure 3.4.1 Ground Truth Survey Points

- Time stump and photographs

Among the 198 points, 15 sampling areas were selected and applied to the classification work as shown below.

Classification Works with Sampling area

The classification work involved both in supervised and supervised method. The classifier considers unknown pixels in the image and aggregates them into a number of classes based on the natural groupings or cluster present in the image. The classes that result from such type of classification are spectral classes. Throughout the processing work, the actual sample areas as below were collected from the existing Landover map (WBISPP) for specific points which were used to classify the Landsat data. Having created a set points reliable signature for each pixel in the images was compared to the signature and labeled as the class mostly resembles. In this process, maximum likelihood decision tile was applied. The process also included image enhancement for the improvement of image interpretability by increasing the distinction between the features in the image scene. A preliminary classifications was made as initial draft map (called as yosatuzu), then the field survey for ground truth was conducted on March and April 2008.

No.	Woreda	X (UTM37, WGS84)	Y(UTM37, WGS84)	Landcover Class
No.1	Bugena	482,113	1,344,243	Shrub land
No.2	Bugena	482,411	1,344,951	Village/Urban
No.3	Bugena	484,848	1,345,716	Cultivation
No.4	kobo	566,489	1,353,085	Cultivation
No.5	kobo	569,155	1,344,559	Woodland
No.6	kobo	568,769	1,340,515	Cultivation
No.7	mekedera	507,734	1,242,078	Woodland
No.8	mekedera	509,970	1,241,205	Grassland
No.9	mekedera	509,347	1,237,928	Grassland
No.10	mekedera	509,314	1,237,736	Plantation
No.11	leganbo	526,735	1,212,991	Grassland
No.12	leganbo	543,014	1,207,213	Bareland
No.13	Ebinat	383,000	1,324,500	BareRock (Basalt)
No.14	Gidan	537,786	1,337,989	Afro-alpine
No.15	GIdan	538,056	1,337,458	Natural Forest (Juniperus)

Note: Table above shows typical points surveyed by the ground truthing. Refer the summary table in Appendix.

3.4.3 Satellite Data Collection

In the Study Area, there were several GIS–remote sensing resources, Woody Biomass Inventory and Strategic Planning Project (WBISPP, 1986), GIS section of Department of Natural Resources Management (Ministry of Agriculture), BoFED (ANRS) and worldwide online open sources such as GLCF (Global Land Cover Facility) and ISCG (International Steering Committee for Global Mapping).

From these organizations or international sources, multi-temporal dataset of satellite images from the following three different satellite systems were collected in order to achieve the objective of the remote sensing analysis.

- LANDSAT (Multi-spectral Scanner / Thematic Mapper / Enhanced Thematic mapper)

  1986-2002 of landcover map (WBISPP covering 64 Woredas)

  1999-2000 of image data (TM, 10 scenes of 1999-2000 covering 64 Woredas)

  2002 of landcover map (DSA products covering 64 Woredas)

- ALOS (Advanced Land Observation Satellite)

  2007-2008 of image data (AVNIR-2. 16 scenes of covering 8 target Woredas)

- MODIS (Moderate Resolution Imaging Spectroradiometer)

2008 of landcover map (ISCG covering Amhara region)

For the selection of satellite images, the criterion of no/minimum cloud was adopted. Finally, 10 scenes of Landsat images for the 64 Woredas and 16 scenes of ALOS images for the 8 target Woredas were selected as shown in Table 3.4.1.

Table 3.4.1 Satellite Images Collected

S. N.	Landsat TM/ETM	Path	Row	Acquisition Date
1	Landsat 5 TM	168	052	1/12/2000
2	Landsat 5 TM	168	053	1/12/2000
3	Landsat 5 TM	169	051	1/19/2000
4	Landsat 5 TM	169	052	1/19/2000
5	Landsat 5 TM	169	053	1/19/2000
6	Landsat 5 TM	170	051	1/10/2000
7	Landsat 5 TM	170	052	1/10/2000
8	Landsat 7 ETM	168	052	12/5/2000
9	Landsat 7 ETM	168	053	4/9/2000
10	Landsat 7 ETM	169	053	10/23/1999

S. N.	Image Scene ID	Satellite Image Acquisition Date
1	ALA V2A 104043360	1/7/2008
2	ALA V2A 101563370	12/21/2007
3	ALA V2A 103313380	1/2/2008
4	ALA V2A 103313370	1/2/2008
5	ALA V2A 099813370	12/9/2007
6	ALA V2A 101563380	12/21/2007
7	ALA V2A 104043350	1/7/2008
8	ALA V2A 105793370	1/19/2008
9	ALA V2A 101563360	12/21/2007
10	ALA V2A 101563350	12/21/2007
11	ALA V2A 104043370	1/7/2008
12	ALA V2A 099813340	12/9/2007
13	ALA V2A 099813350	12/9/2007
14	ALA V2A 099813360	12/9/2007
15	ALA V2A 104043380	1/7/2008
16	ALA V2A 105793380	1/19/2008

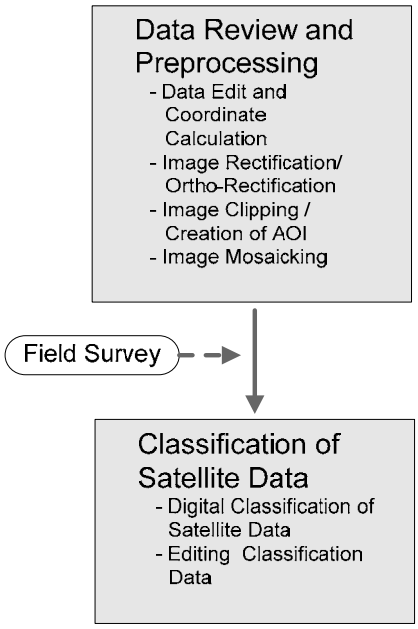


Figure 3.4.2 Workflow of Satellite Data Analysis

3.4.4 Satellite Image Analysis

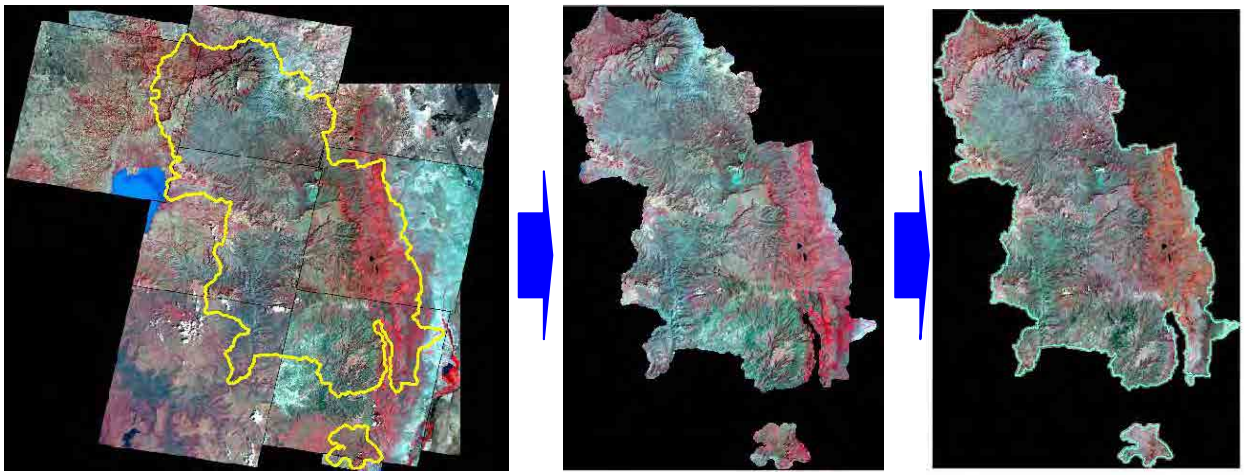
The analyses of satellite images were generally carried out with the two steps, “Data Review and Preprocessing” and “Classification of Satellite Data”, as shown in Figure 3.4.2.

(1) Data Review and Preprocessing

< Landsat Images >

Among the used Landsat scenes, some were obtained as ortho-rectified while others were without ortho-rectified (level 1G). Hence, after importing the latter Landsat scenes, they were firstly ortho-rectified with GCPs from 1:250,000 existing topographic maps and DEM from SRTM (Shuttle Radar Topography Mission) data produced by NASA (National Aeronautics and Space Administration), which was available free on the internet. Altogether, 14 map sheets of 1:150,000 scaled topographic maps were used to collect GCPs. For easiness and maintaining the location accuracy of the collected GCPs, the exiting topographic maps were scanned and then firstly geo-rectified to UTM with original spheroid and datum (as mentioned in 1:250,000 topographic maps) and then re-projected to spheroid and datum as WGS84. After completion of ortho-rectification process, the preparation for mosaicking was done by replacing the cloud covered area by the other scenes without clouds. All the Landsat

scenes were mosaicked to one scene, and then clipped using the boundary that covered all the 64 Woredas. The boundary data was prepared by dissolving the existing Woreda data and then applying 2.5km buffer. Thus, the clipped Landsat image included even the data of 2.5km outer side from the boundary of 64 Woredas. The band combinations selected for the layout was 4, 3 and 2 (as R, G and B) which indicate the vegetation in red color as shown in Figure 3.4.3.



Landsat Images Scenes and Study Area Boundary with 2.5km buffer

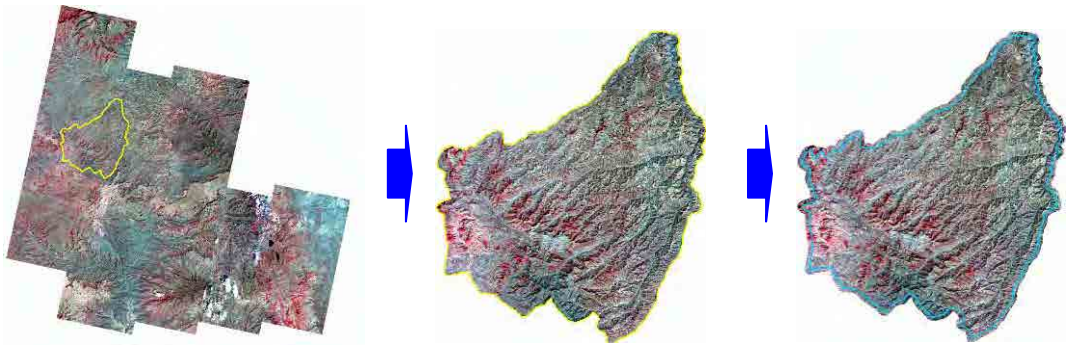
Mosaicked Clipped Images with 2.5km Buffered Boundary)

Clipped Images and Study Area Boundary

Figure 3.4.3 Landsat Scenes and Mosaicked-clipped Image

< ALOS Images >

1B2R geo-referenced level of AVNIR-2 ALOS satellite data was purchased as TIFF format, which were imported for the preprocessing. Despite the data as geo-referenced, some discrepancy was found at the overlapping area between the two scenes, which was removed by applying further geometric correction. After that, all the ALOS scenes were mosaicked, then the data covering the 8 Woredas were clipped separately, as shown in Figure 3.4.4. For Kobo Woreda and part of Gidan Woreda where ALOS image was lacking, Landsat data was clipped from the Landsat image prepared for the 64 Woredas. Lastly, for Gidan Woreda, ALOS and Landsat images were mosaicked into one image.



ALOS Mosaicked Images Ebinate Woreda Boundary with 1.0km buffer

Clipped Images with 1.0km Buffered Boundary

Clipped ALOS Images and Ebinate Woreda Boundary

Figure 3.4.4 Mosaicked ALOS Image and Clipped ALOS Covering Ebinate Woreda

(2) Classification of Satellite Data

The classification of satellite data was made with the "supervised option" using 15 sampling areas selected from the field survey. The landcover classification for "supervised option" is described below.

a) Landcover Classification

Landcover classification was adopted by the same category as WBISPP. In order to compare different sources of landcover maps and to trace the historical changes of vegetation, the following comparative table is also prepared.

Table 3.4.2 Landcover Classification

Value	Classification (WBISPP)	Value	Classification (ISCGM)	Classification for Area Calculation
5	Highland Bamboo*	1	Broadleaf Evergreen Forest	Forest
		2	Broadleaf Deciduous Forest	
		3	Needleleaf Evergreen Forest	
		4	Needleleaf Deciduous Forest	
6	Natural Forest	5	Mixed Forest	
12	Woodland	6	Tree Open	Shrub
8	Shrubland	7	Shrub	
4	Grassland	8	Herbaceous, single layer	Grassland
1	Afro-alpine	9	Herbaceous with Sparse Tree / Shrub	
		10	Sparse Vegetation	
7	Plantation	11	Cropland	Plantation
		12	Paddy field*	
3	Cultivation	13	Cropland / Natural Vegetation Mosaic	Cultivation
11	Wetland	14	Mangrove*	Wetland
		15	Wetland	
2	Bareland	16	Bare area, consolidated (gravel, rock)	Bareland
		17	Bare area, unconsolidated (sand)	
9	Urban	18	Urban	Urban
10	Water	19	Snow / Ice*	Water
		20	Water Bodies	

Note: * category marked *(asterisks) is not found in the Study Area (64 Woredas).

b) AOI (area of interesting) for Landcover Classification

Images were clipped and the AOI were prepared for each of proposed classification except for "Highland Bamboo", which was not observed in the 64 Woreda areas. Using the AOI, signature file was created, which was used to perform "supervised option". At the initial stage of processing, plural methods (Maximum likelihood, Minimum distance and Mahalanobis) were simultaneously applied for identifying best matching method with less error. After the trials, the maximum likelihood was judged as the best method and then applied to all other AOIs. The probability option was also used to control the extent of coverage of each classification.

As for the classifications having two or more signatures, they were combined to one. Also, for the items like Urban, Water, some misclassifications, they were corrected to other suitable classifications. Finally, with the help of the delineated AOIs, the coverage of cloud area was added to the classified data.

As for the 7 images of 1999-2000 Landsat, the result was almost the same as that of existing study because of using the same source provided by GLCF. The land cover maps for three different scenes are shown in Figure 3.4.5 and Figure 3.4.6.

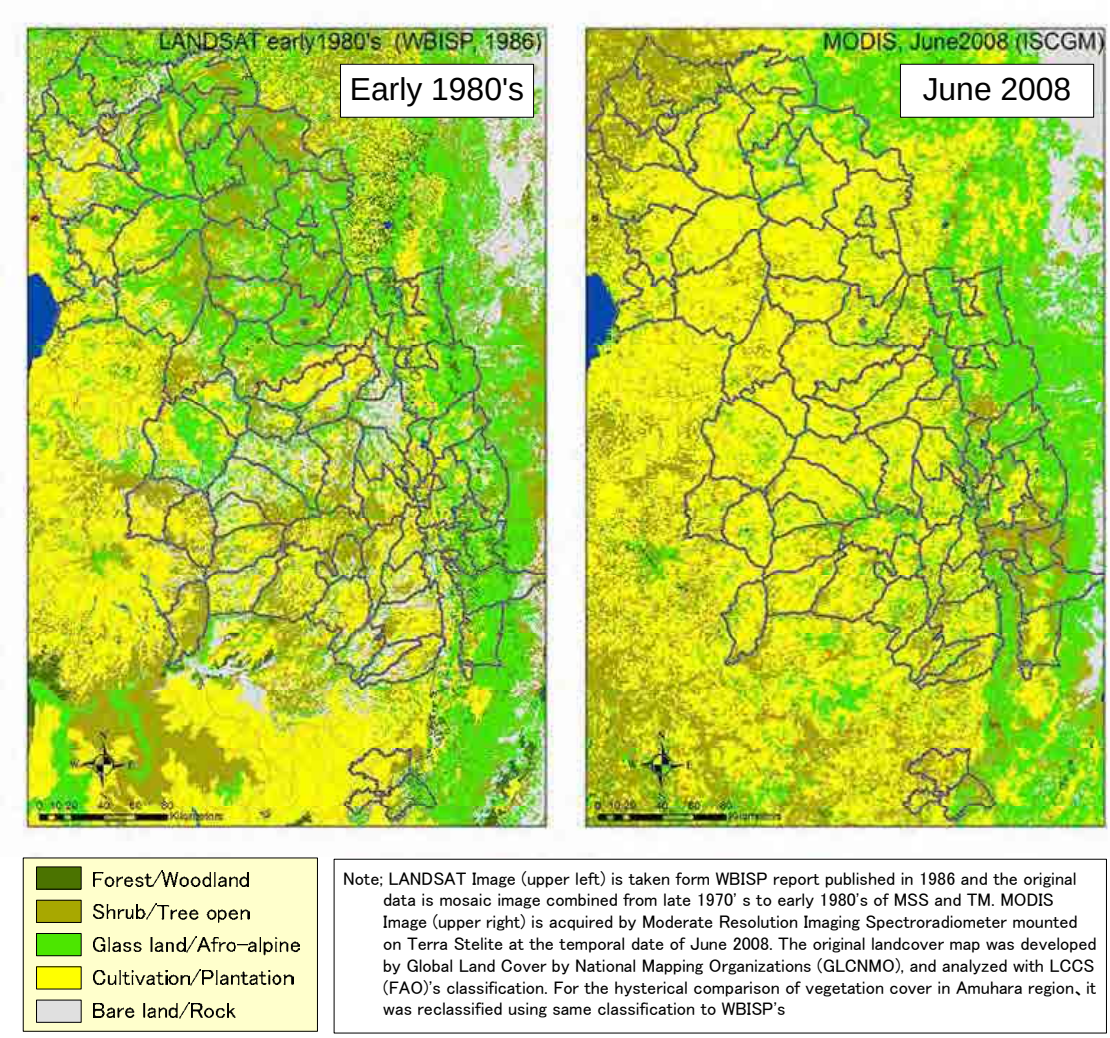


Figure 3.4.5 Landcover Map (early 1980s and 2008)

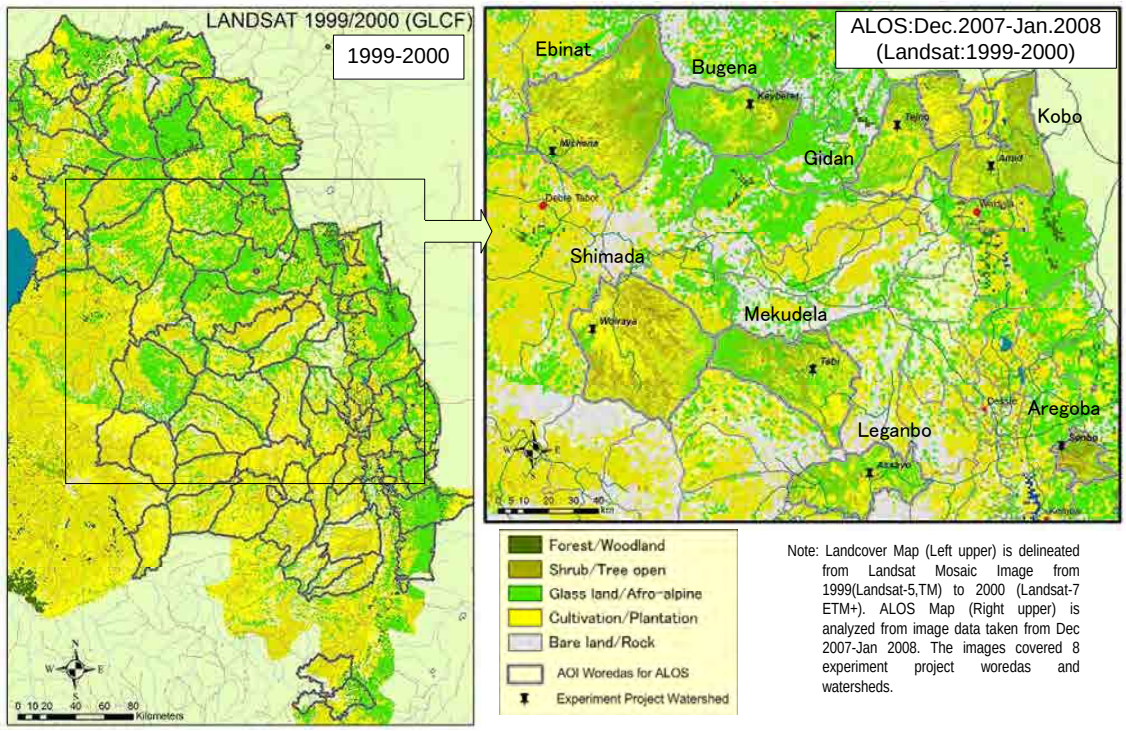


Figure 3.4.6 Landcover Map (1999/2000 and Dec. 2007-Jan. 2008)

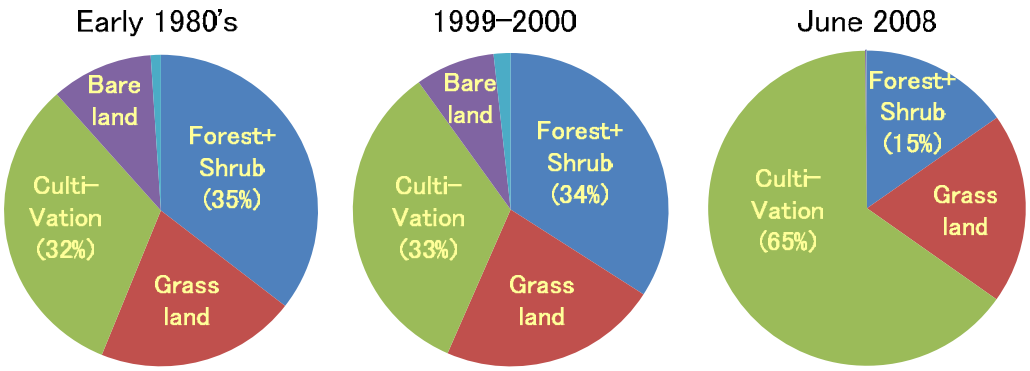
c) Landcover Area

Area of the 64 Woredas is about 71,890 km^2. Based on the AOI data, temporal change of land cover was traced for three (3) decades. The change on land cover from early 1980s to June 2008 is summarized in Table 3.4.3.

Table 3.4.3 Area for Classification

Early 1980's (Landsat-4,5 WBISP)		1999-2000 (Landsat-5,7)		June 2008 (MODIS,ISCGM)	
Classification	Total(sqkm)	Classification	Total(sqkm)	Classification	Total(sqkm)
Forest	1,308	Forest	1,309	Forest	83
Shrubland	24,170	Shrubland	23,161	Shrubland	10,917
Grassland	14,922	Grassland	16,212	Grassland	13,998
Plantation	416	Plantation Forest	369	-	
Cultivation	22,736	Cultivation	23,700	Cropland / Natural Vegetation Mosaic	46,750
Bareland	7,586	Rock	5,887	Bareland	108
Urban	172	-	-	-	-
Wetland	534	Swamp	149	Water Bodies	34
Water	52	Water	41	-	-
-	-	not identified	1,068	-	-
Total	71,896	Total	71,896	Total	71,890

With the comparison between Landsat 1980 and 1999/2000 images, the composition of land cover was not drastically changed, 35 to 34% of forest and shrubs and 32 to 33 % of cultivation. It might result from the fact that both AOIs were mixed with different timing of Landsat images and were not identified the specific season for both results. However, comparing the Landsat 2000 and the MODIS 2008 images, coverage of forest and shrubs decreased by 15 %. The change of landcover composition is summarized in Figure 3.4.7.



Area for Classification (km2)

Image Date	Early1980's	1999-2000	June 2008
Forest+Shrub	25,478	24,470	11,000
Grassland	14,922	16,212	13,998
Cultivation	23,152	24,069	46,750
Bareland	7,586	5,887	108
Others	758	1,258	34
Total	71,896	71,896	71,890

Area for Classification (%)

Image Date	Early1980's	1999-2000	June 2008
Forest+Shrub	35	34	15
Grassland	21	23	19
Cultivation	32	33	65
Bareland	11	8	0
Others	1	2	0
Total	100	100	100

Figure 3.4.7 Changes of Landcover Composition

3.4.5 GIS Applications - Water Balance and Soil Erosion Analysis by SWAT Model

(1) Outline of SWAT Model

Using SWAT and GIS applications (SWAT 2005, Soil and Water Resources Tool), behavior of water and soil was analyzed for the 4 basins of Abay (Blue Nile), Takeze, Afar Interior and Awash covering 168,000 km^2.

SWAT and GIS Application

The analytical tool applied is called as SWAT (the acronym for 'Soil and Water Assessment Tool'), a river basin, or watershed, scale model developed for USDA Agricultural Research Service. It has been properly developed to predict impact of land management practices on water, sediment and agricultural chemical yields in large complex watersheds with varying soils, land use and management conditions over long periods of time.

Here, SWAT was used for the evaluation of current hydrologic situation and related soil erosion of the 64 Woredas and the 8 target watersheds. Also the general information of a replenishment water amount was estimated for major basins in the Study Area. The physical processes to analyze the water balance are briefly summarized below.

(2) Catchments Delineation

As a preparatory process of SWAT modeling, four basins were partitioned into 57 to 403 sub-basins (called as 'catchments' in SWAT) respectively.

- Blue Nile (Abay) Basin: 403 catchments
- Takeze (At Bara) Basin: 280 catchments
- Awash Basin: 182 catchments
- Afar Interior Basin: 57 catchments

The use of catchments in the simulation is particularly beneficial when different areas of the watershed are

characterized by different water use properties giving hydrological impacts.

To partition the watershed into catchments, DEM was applied in consideration of distribution and stream network for wide-scaled (watershed) analysis.

Using algorism of automatic delineation and segmentation of watersheds, the area was divided into 921 catchments for all the basins with various areas ranging form 1 to 882 km^2. Figure 3.4.8 shows major watershed applied for catchments division.

(3) Preparation of Input Information

As a preparation of SWAT run, the meteorological and hydrological information was prepared beforehand as input information. In general, input information for each sub-basin was to be grouped or organized into the following categories.

a. Climate data

b. Land use map and soil taxonomy map

c. Hydrologic response units or HRUs

d. Hydrologic data

- Dam/Ponds/wetlands
- Groundwater; and the main channel, or reach
- Draining the catchments

Figure 3.4.8 Catchments for SWAT

(4) Model Output

In the Study Area, river discharge and soil erosion exclusively occurs in rainy season on steep slope. With normal precipitation, it may be intercepted and held in the vegetation canopy or fall to the soil surface, or later lost by evaporation.

With the heavy rain, water flows as runoff on land and moves quickly toward a stream channel and contributes short-term stream response with soil erosion. While at the down reach of river courses,

especially lain by superficial deposits or porous sedimentary rocks, water begin to be infiltrated into the subsurface. Even the water in the soil layer will be lost by evapotranspiration and the rest of water may slowly make its way to the surface-water system via underground paths. Along with the potential pathways of water movement causing soil erosion, flowing outputs (a)-(i) were selected and post-processed among SWAT's outputs.

a. Area Rainfall
b. Potential Evapotranspiration
c. Actual Evapotranspiration
d. Soil Water Content
e. Percolation / Groundwater Recharge
f. Surface runoff to Channel
g. Base flow to Channel
h. Water Yield (Surface Runoff)
i. Sediment Yield (Soil Erosion)

a) Area rainfall

Area rainfall was calculated from the records. The area precipitation for catchments ranged from 560 mm/year to 1,200 mm/year on 5-year average (2002-2006) for the basin, as shown in Figure 3.4.9.

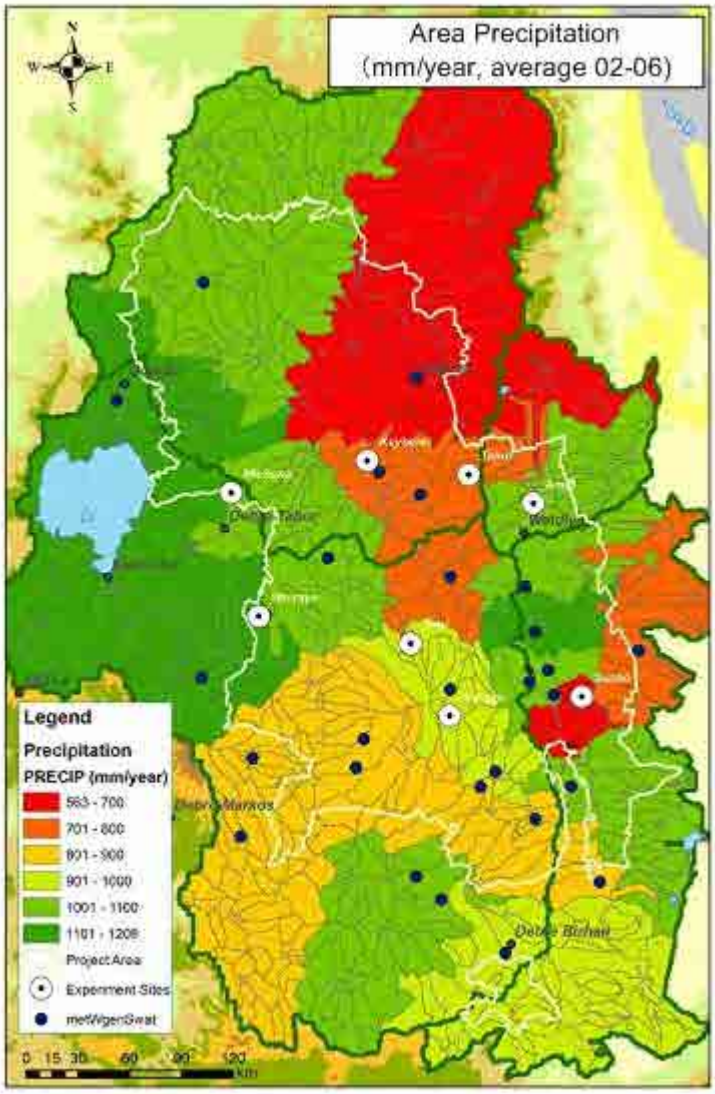


Figure 3.4.9 Area Precipitation

b) Potential evapotranspiration

Potential evapotranspiration is the rate at which evapotranspiration would occur from a large area covered with growing vegetation which has access to an unlimited supply of soil water. The calculation was made with Penman-Monteith method, and a range of 870 to 2,510 mm/year was obtained, as shown in Figure 3.4.10.

c) Actual evapotranspiration

The calculated value of evapotranspiration includes evaporation from rivers and lakes, bare soil, and vegetative surfaces (transpiration from plant leaves). The model computed evaporation from soils and plants separately. Potential soil water evaporation was estimated as a function of potential evapotranspiration and leaf area index. Actual soil water evaporation was estimated by using

exponential functions of soil depth and water content. Plant transpiration was simulated as a linear function of potential evapotranspiration and leaf area index. As a result of the calculations, 270 to 1,720 mm/year of actual evapotranspiration was given, as shown in Figure 3.4.11.

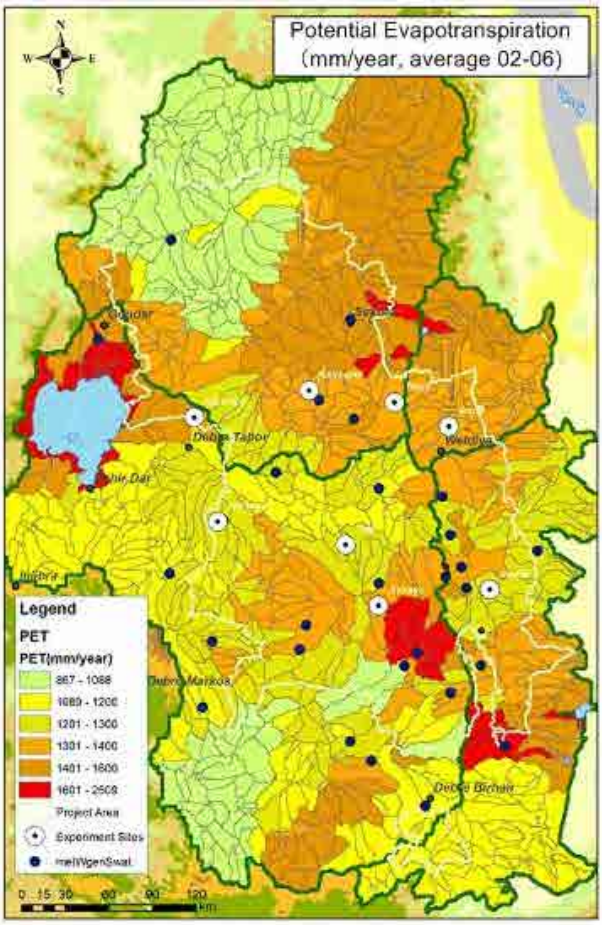


Figure 3.4.10 Potential Evapotranspiration

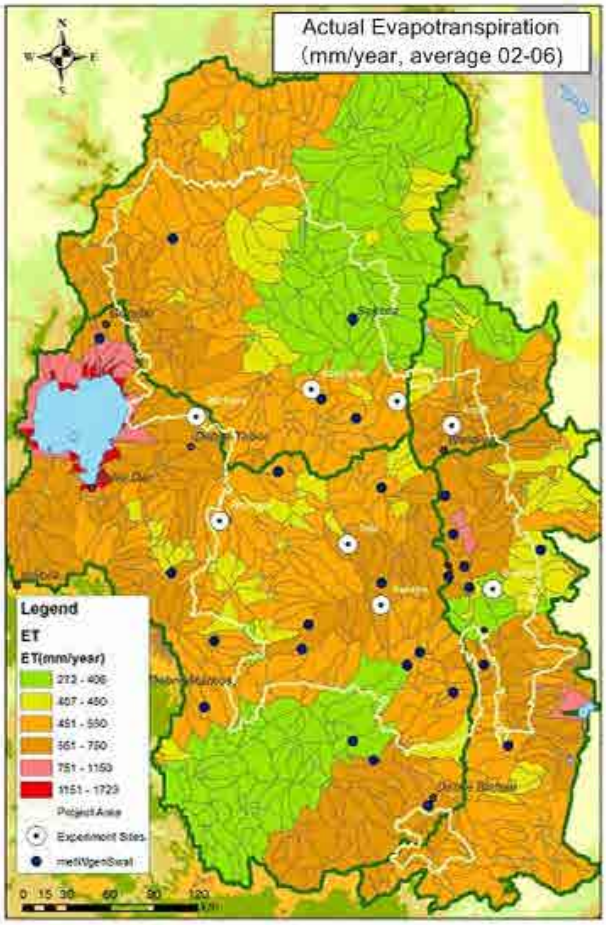


Figure 3.4.11 Actual Evapotranspiration

d) Soil water content

Soil water content was calculated by the Green-Ampt and Mein-Larson method. The method is to predict infiltration with an assumption of surface runoff occurring by rainfall. When the rainfall intensity is less than the infiltration rate, all the rainfall infiltrates during the period and it is cumulative infiltration. Inversely, when its intensity is higher than the infiltration, excess water turns to surface runoff. As water infiltrates into the soil the method assumes the soil, above the wetting front. At the front, there is sharp break in moisture content between the areas, beyond the forest and its backward, and these areas show different hydraulic conductivity parameters, respectively. The result of simulation at 31 Dec. 2006 is given in Figure 3.4.12.

e) Percolation (groundwater recharge – initial gross amount)

Percolation for a soil layer was calculated. Water is allowed to percolate if the water content exceeds the field water content capacity for that soil layer. Water that moves and passes the lowest soil layer by percolation, and then if enters and flows through the vadose zone, and finally it flows into the aquifer. The percolation time (the water exits the soil layer until it enters the shallow aquifer) depends on the depth to the water table and the hydraulic properties of the geologic formations in the vadose and

groundwater zones. If the time is long enough for water to move from the soil layer into the aquifer, it can be said that the amount of percolation water is almost the same as groundwater recharge. In the calculation, percolation amount was treated as groundwater recharge amount. The result of percolation analysis shows different rates as observed in Figure 3.4.13.

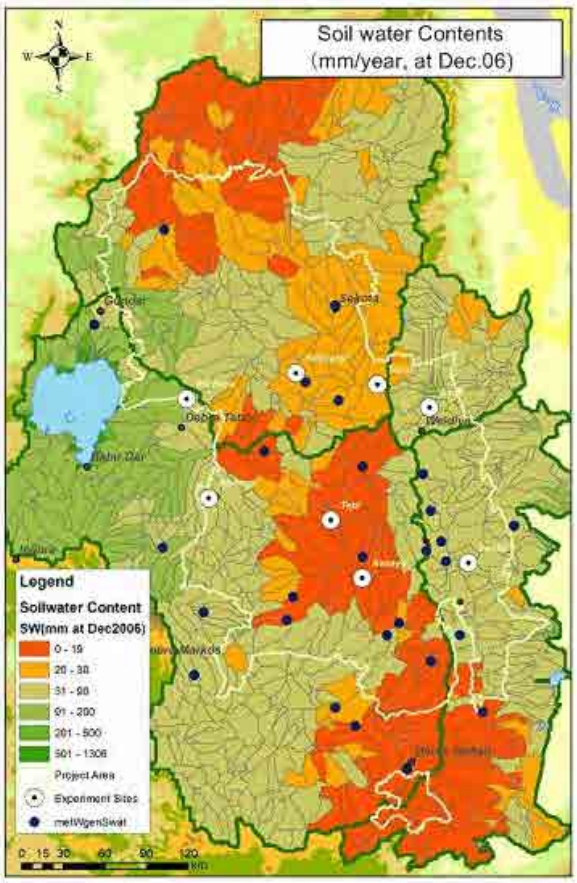


Figure 3.4.12 Soil Water Content

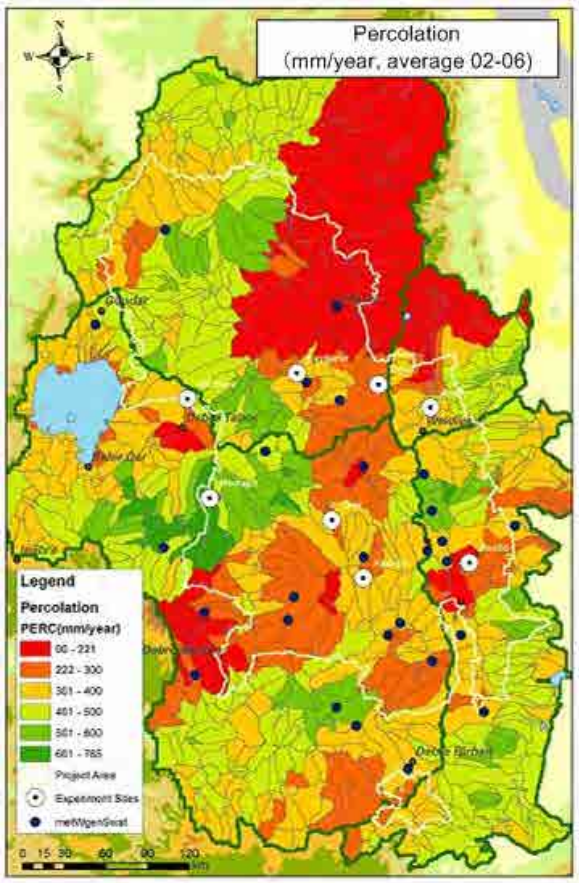


Figure 3.4.13 Percolation (GW Recharge)

f) Surface runoff to channel

In SWAT, the surface runoff, or overland flow, is flow that occurs along a sloping surface. Using daily amounts, SWAT simulates surface runoff volumes and peak runoff rates by hydrologic response unit (HRU). Surface runoff volume was computed using a modification of the SCS curve number method (USDA Soil Conservation Service, 1972). In the curve number method, the curve number varies non-linearly with the moisture contents of soil. The number drops as the soil approaches the wilting points and increases to nearly 100 as the soil approaches saturation. The surface runoff contribution to channel is show in Figure 3.4.14.

g) Base flow to channel

Base flow is the volume of stream flow originating from groundwater. SWAT partitions groundwater into two aquifer systems: a shallow unconfined aquifer which contributes return flow to streams within the watershed and a deep confined aquifer which contributes return flow to streams outside the watershed (Arnold et al 1993). Groundwater contribution of stream flow (called as baseflow here) is shown in Figure 3.4.15.

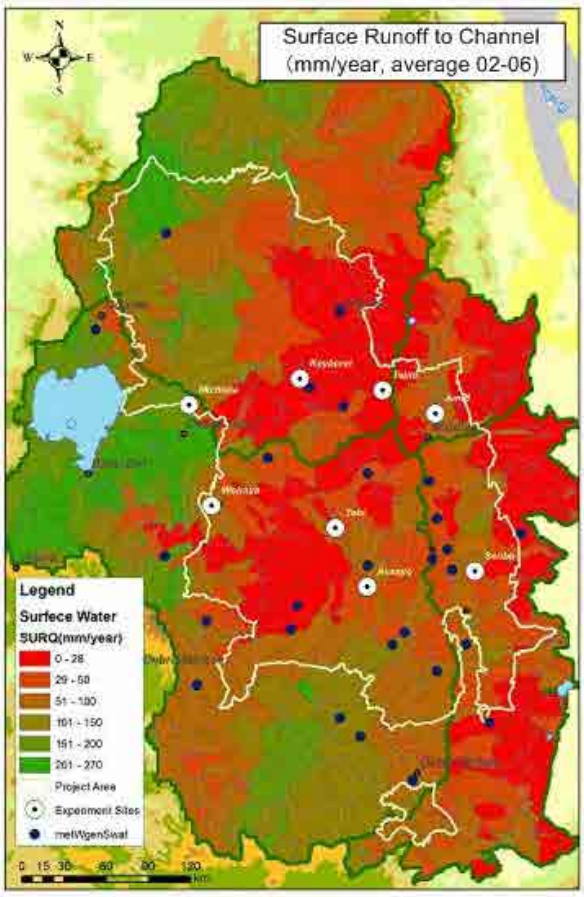


Figure 3.4.14 Surface Runoff to Channel

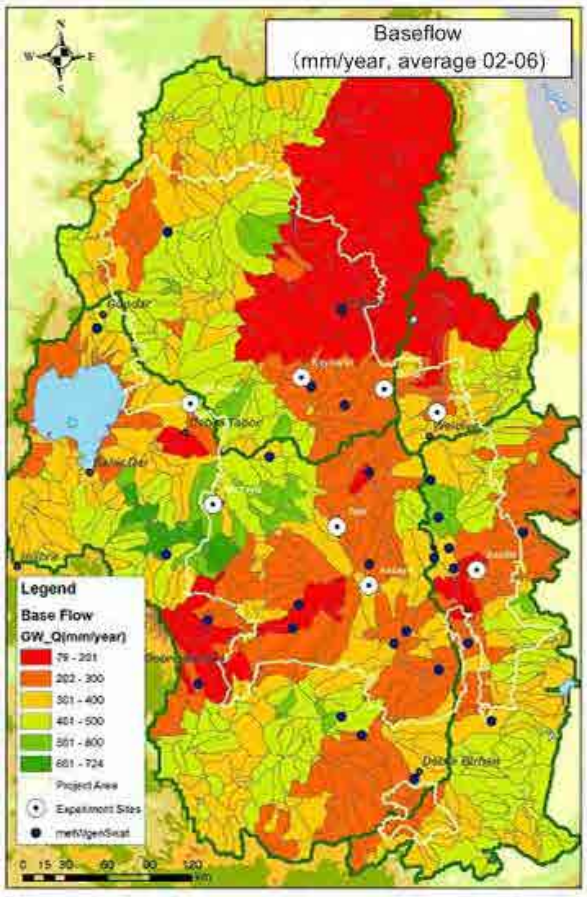


Figure 3.4.15 Baseflow to Channel

h) Water yield (surface runoff)

Flow in a watershed is classified as overland and channelized. The primary difference between the two flow processes is that water storage and its influence on flow rates is considered in channelized flow. Main channel processes modeled by SWAT include the movement of water in the stream net work.

Open channel flow is defined as channel flow with a free surface, such as flow in river or partially full pipe. SWAT uses Manning's equation to define the rate and velocity of flow. Water is routed through the channel network using valuable storage routing method.

SWAT treats the volume of outflow calculated with valuable storage routing method as the net amount of water removed form the reach. As transmission losses, evaporation and other water losses for the reach segment are calculated, the amount of outflow to the next reach segment is reduced by amount of the loss. When outflow and all losses are summed, the total amount will equal the value obtained from valuable storage routine method.

In Figure 3.4.16, surface runoff (called as Water yield in SWAT as the same meaning of surface runoff of catchments) is shown.

i) Sediment yield

In the calculations of SWAT, erosion caused by rainfall and runoff is computed with Modified Universal Soil Loss Equation: MUSLE (Williams, 1975). MUSLE is a modified version of the

Universal Soil Loss Equation (USLE) developed by Wischmeier and Smith (1965, 1978). The value is calculated with factors of daily surface runoff, peak runoff, erodability factor (based on soil properties), landcover and topographical condition and so on.

The SWAT supplies estimates of runoff and peak runoff rates. The crop management factor, a function of above-ground biomass, residue on the soil surface, is recalculated. The result of sediment yield is shown in Figure 3.4.17. It shows transported sediment volume to rills and channels as net soil loss. Estimation for delivery ratio between gross and net soil loss was made by LUPRD/UNDP/FAO (1984), and resulted in 10% of gross erosion as net erosion. Hence, in sediment yield map (Figure 3.4.17), the gross erosion is correlative to around 100 ton/ha/year for most of the Study Area except north Gondar (western frank of Mt. Ras Dashen) and north Shewa.

In the Study Area, the gross soil loss ranges 1 to over 40 mm/year with 10 mm/year on average, and is relatively low at the northern part where the Takeza basin lies. This low rate might result from less precipitation. However, according to the satellite image analysis (refer to Figure 3.4.18), the recent decade deforestation is prominent in its upper reach. It may become a negative factor to accelerate the soil erosion in the Takeze basin.

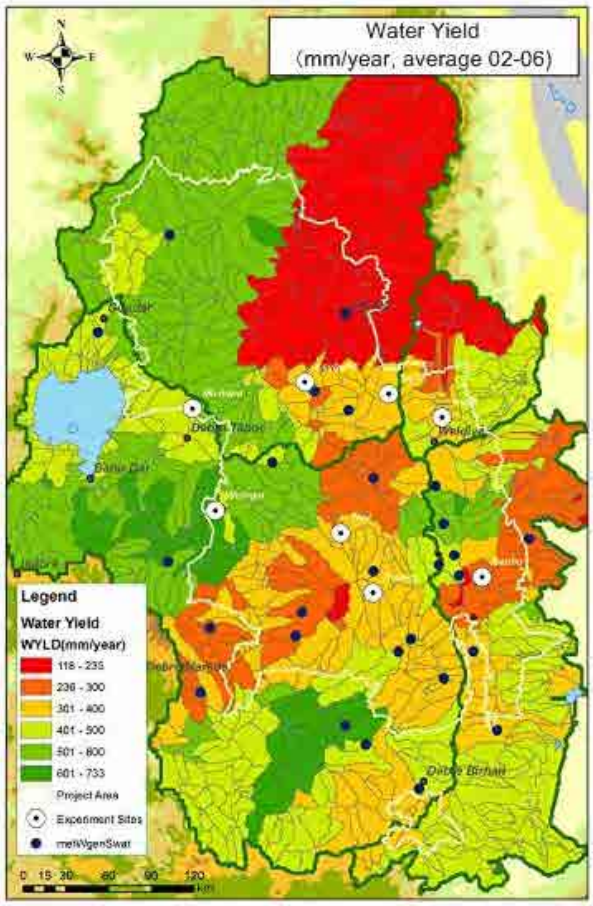


Figure 3.4.16 Water Yield

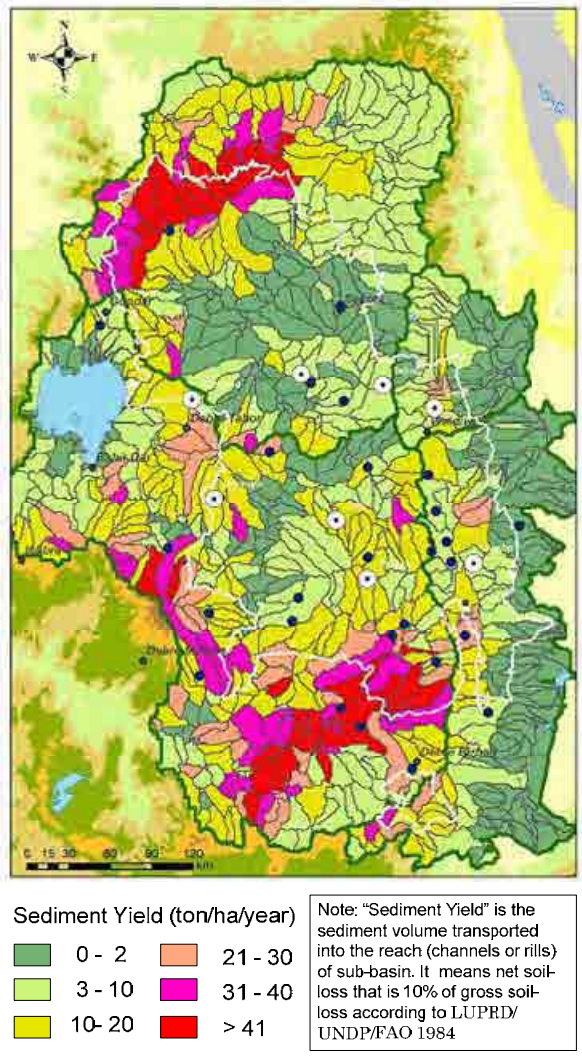


Figure 3.4.17 Sediment Yield

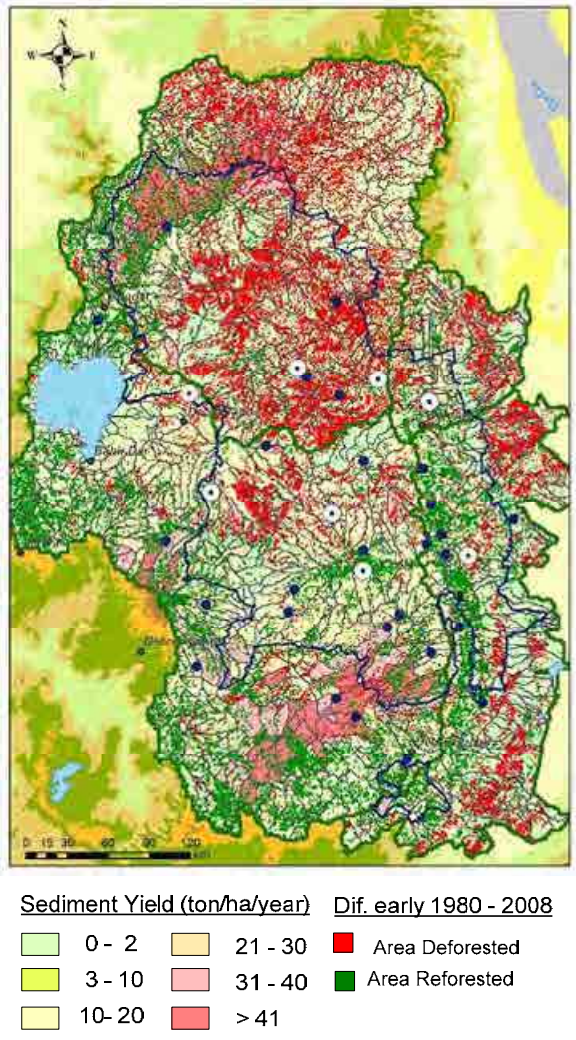


Figure 3.4.18 Deforested Area

3.5 Categorization of the 64 Food Insecure Woredas

The 64 food insecure Woredas were categorized by analyses of three sector data: natural environment, socio-economy, and agriculture and livestock. Because there were many viewpoints to compare the 64 Woredas, there were many kinds of categorization even in one sector. This implied that categorized results in the same sector were different according to the data applied. Also, even in the same Woreda, the situations are not uniform. For instance, 3.5 types of agro-climatic zones exist within one Woreda on average.

Moreover, these results of categorization were not always well-matched with geographical distribution of the 64 Woredas, particularly, the socio-economic data. This came from the fact that the many human activities such as education and urbanization were related to cultural, administrative and social conditions rather than geographical and/or natural conditions. Also the 64 Woredas had their own specific features that were not included in the statistical data analyzed here.

These facts resulted in difficulty of composition of the categorized results of several sectors. Hence the overall composite of the categorization features wasn't done, and the 64 Woredas were categorized by sector as presented below.

3.5.1 Natural Environment

(1) Methodology

The 64 Woredas are categorized by two criteria: elevation and annual rainfall. For elevation, data from Digital Elevation Model (DEM) analysis which Shuttle Radar Topography Mission (SRTM) has conducted elevation analysis by using digital topographic data of NASA (National Aeronautics and Space Administration, USA) are adopted. For rainfall, data from NMA (National Meteorological Agency, Ethiopia) are adopted. The data are based on rainfall information from meteorological stations in the 64 Woredas. ArcGIS, a GIS software, is used to compute and analyze weighted mean elevation and mean annual rainfall. After that, the 64 Woredas were classified into elements of the agro-climatic zones developed by the Ministry of Agriculture and Rural Development (MoARD). (See Table 3.5.1.)

(2) Rainfall

As shown in the Table 3.5.2, the mean annual rainfall of the 64 Woredas is 939 mm, with the minimum of 466 mm in Bati, Dewa Harewa, Aregoba and Worebabu Woredas, and the maximum of 1,224 mm in Alebuko and Kalu Woredas. In total 41 Woredas are classified into 900 - 1,400 mm while 23 Woredas are less than 900 mm.

(3) Elevation

The traditional agro-climatic zone was classified by elevation only until MoARD adopted new agro-climatic zone by elevation and rainfall. As shown in the Table 3.5.3, the average of weighted mean elevation of the 64 Woredas is 2,166 m. The average of the highest and the lowest elevations are 3,324 m and 1,298 m respectively. It means that the average of elevation range in the 64 Woreda is as much as 2,026 m. Since each Woreda has a wide range of altitude, the classification of each Woreda is determined according to the percentage of area dominating each zone. In the case of Ebinate Woreda, for example, the weighted mean elevation is 2,002m: however, apart from this fact, it is also confirmed that 76.2 % of the total area falls into 1,500-2,300 m range, 18.5 % into 2,300-3,200 m and 5.3 % into 500-1,500 m. That is, the most dominant elevation in Ebinate Woreda is resulted as 1,500-2,300 m and it is classified as the elevation of 1,500-2,300m.

Table 3.5.1 Classification of Agro-climatic Zones in Ethiopia

Agro-climatic Zones		Annual Rainfall		
		< 900 mm	900 - 1,400 mm	> 1,400 mm
Elevation	> 3,700 m	Dry Alpine Wurch A: None (dry and too cold) C: None (dry and too cold) S: Black soils, degraded T: Lichens, *Hypericum quartinianum* , *Hypericum roeperianum*	Moist Alpine Wurch A: None (frost limit) C: None (frost limit) S: Dark black soils, shallow T: *Hypericum quartinianum* , *Hypericum roeperianum*	Wet Alpine Wurch A: None (too cold and too wet) C: None (too cold and too wet) S: Dark black soils, deep T: Grasses, *Hypericum quartinianum* , *Hypericum roeperianum*
	3,200 - 3,700 m	Dry Wurch A: Only barley, single cropping per year C: Drainage none S: Gray soils, degraded T: *Erica* species	Moist Wurch A: Only barley, single cropping per year C: Drainage rare S: Black soils, degraded T: *Erica* and *Hypericum* species	Wet Wurch A: Only barley, 2 crops per year C: Wide-spread drainage ditches S: Black soils, highly degraded T: *Erica* and *Hypericum* species
	2,300 - 3,200 m	Dry Dega A: Barley, wheat and pulses C: Traditional moisture conservation measures, e.g. furrow with tie-ridges S: Gray to brownish gray soils T: *Olea europaea*	Moist Dega A: Barley, wheat and pulses C: Few traditional terracing S: Brown clay soils T: *Juniperus procera, Hagenia abyssinica, Podocarpus falcatus*	Wet Dega A: Barley, wheat, nug and pulses, 2 crops per year C: Wide-spread drainage ditches S: Dark brown clay soils T: *Juniperus procera, Hagenia abyssinica, Podocarpus falcatus*
	1,500 - 2,300 m	Dry Weyna Dega A: Wheat, teff, rarely maize C: Terracing wide spread S: Light brown yellow soils T: Acacia savannah	Moist Weyna Dega A: Maize, sorghum, teff, ensete (rare), wheat, nug, dagussa and barley C: Traditional terracing S: Red brown soils T: *Acacia* species, *Cordia africana*	Wet Weyna Dega A: Maize, teff, ensete (in west parts), wheat, nug and barley C: Widespread drainage S: Red clay soils, deeply weathered, gullies frequent T: *Acacia* species, *Cordia africana*
	500 - 1,500 m	Dry Kolla A: Sorghum rarely, teff C: Water retension terraces S: Yellow sandy soils T: Acacia bushes and trees	Moist Kolla A: Sorghum, teff rarely, nug, dagussa C: Widespread terracing S: Yellow silty soils T: *Acacia* , *Erythrina* , *Cordia* and *Ficus* species	Wet Kolla A: Mango, taro, sugar cane, maize, coffee, citrus C: Ditches frequent S: Red clay soils, highly oxidized T: *Milicia excelsa* , *Cyathea manniana*
	< 500 mm	Dry Bereha A: Possibly only with irrigation C: Wind erosion frequent S: Aridsol, rigosols, silty and sandy T: *Acacia senega* l, *Acacia bussei* and *Tamarix aphyla*	Moist Bereha A: Seasonal rain-fed agriculture C: Burning grasses common, no wind erosion due to cover of tall grasses S: Silty and clayey, mainly black T: *Ziziphus pubescens* , *Antiaris toxicaria*	

A: Main Crop C: Traditional Soil Conservation S: Soil on Slopes T: Natural Trees and other Vegetation

Table 3.5.2 Annual Rainfall in the 64 Woredas

No.	Woreda	Zone	Rainfall (mm)				Seasonal/Annual Rainfall (%)		
			Annual	Kiremt*	Belg**	Bega***	Kiremt*	Belg**	Bega***
1	Enebse Sar Mider	East Gojam	824	584	148	92	70.9	17.9	11.2
2	Goncha Siso Enese	East Gojam	824	584	148	92	70.9	17.9	11.2
3	Shebele Berenta	East Gojam	808	582	173	53	72.0	21.4	6.6
4	Adarekaye	North Gonder	1,059	923	81	55	87.1	7.7	5.2
5	Beyeda	North Gonder	550	468	58	23	85.2	10.6	4.3
6	Dabat	North Gonder	1,059	923	81	55	87.1	7.7	5.2
7	Debark	North Gonder	1,059	923	81	55	87.1	7.7	5.2
8	East Belesa	North Gonder	1,157	946	106	105	81.7	9.1	9.1
9	Janamora	North Gonder	550	468	58	23	85.2	10.6	4.3
10	Telemt	North Gonder	550	468	58	23	85.2	10.6	4.3
11	West Belesa	North Gonder	1,157	946	106	105	81.7	9.1	9.1
12	Wogera	North Gonder	1,157	946	106	105	81.7	9.1	9.1
13	Angolelana Tera	North Shewa	1,061	632	260	169	59.5	24.5	15.9
14	Asagirt	North Shewa	1,061	632	260	169	59.5	24.5	15.9
15	Gishe Rabele	North Shewa	493	358	75	60	72.6	15.2	12.2
16	Menze Gera Mider	North Shewa	878	720	112	46	82.0	12.8	5.2
17	Menze Lalo Mider	North Shewa	1,061	632	260	169	59.5	24.5	15.9
18	Menze Mama Mider	North Shewa	1,061	632	260	169	59.5	24.5	15.9
19	Menze Qeya Gebriel	North Shewa	1,114	849	148	117	76.2	13.3	10.5
20	Bugena	North Wello	1,162	964	118	80	82.9	10.2	6.9
21	Dawunt	North Wello	1,087	869	161	57	79.9	14.8	5.3
22	Delanta	North Wello	1,025	585	279	160	57.1	27.2	15.7
23	Gidan	North Wello	781	635	102	44	81.3	13.1	5.7
24	Guba Lafto	North Wello	781	635	102	44	81.3	13.1	5.7
25	Habru	North Wello	1,025	585	279	160	57.1	27.2	15.7
26	Kobo	North Wello	781	635	102	44	81.3	13.1	5.7
27	Lasta	North Wello	1,162	964	118	80	82.9	10.2	6.9
28	Mekete	North Wello	1,162	964	118	80	82.9	10.2	6.9
29	Wadela	North Wello	1,087	869	161	57	79.9	14.8	5.3
30	Artuma Fursi	Oromiya	1,080	577	268	235	53.4	24.9	21.8
31	Bati	Oromiya	466	266	112	89	57.1	23.9	19.0
32	Dewa Chefa	Oromiya	493	358	75	60	72.6	15.2	12.2
33	Dewa Harewa	Oromiya	466	266	112	89	57.1	23.9	19.0
34	Jilena Timuga	Oromiya	1,080	577	268	235	53.4	24.9	21.8
35	Ebinate	South Gonder	1,157	946	106	105	81.7	9.1	9.1
36	Laye Gayint	South Gonder	1,162	964	118	80	82.9	10.2	6.9
37	Libo Kemkem	South Gonder	1,157	946	106	105	81.7	9.1	9.1
38	Simada	South Gonder	1,087	869	161	57	79.9	14.8	5.3
39	Tach Gayint	South Gonder	1,087	869	161	57	79.9	14.8	5.3
40	Alebuko	South Wello	1,224	785	325	114	64.1	26.6	9.3
41	Ambassel	South Wello	1,198	719	341	138	60.0	28.4	11.5
42	Aregoba Special	South Wello	466	266	112	89	57.1	23.9	19.0
43	Debre Sina	South Wello	824	584	148	92	70.9	17.9	11.2
44	Dessie Zuria	South Wello	1,001	679	231	92	67.8	23.0	9.1
45	Jamma	South Wello	1,114	849	148	117	76.2	13.3	10.5
46	Kalu	South Wello	1,224	785	325	114	64.1	26.6	9.3
47	Kelela	South Wello	1,114	849	148	117	76.2	13.3	10.5
48	Kuta Ber	South Wello	1,001	679	231	92	67.8	23.0	9.1
49	Legambo	South Wello	1,001	679	231	92	67.8	23.0	9.1
50	Legehida	South Wello	1,001	679	231	92	67.8	23.0	9.1
51	Mehal Sayint	South Wello	824	584	148	92	70.9	17.9	11.2
52	Mekedela	South Wello	1,001	679	231	92	67.8	23.0	9.1
53	Sayint	South Wello	1,001	679	231	92	67.8	23.0	9.1
54	Tehulederie	South Wello	1,086	724	224	139	66.6	20.6	12.8
55	Tenta	South Wello	1,001	679	231	92	67.8	23.0	9.1
56	Wogedi	South Wello	824	584	148	92	70.9	17.9	11.2
57	Wore Illu	South Wello	1,001	679	231	92	67.8	23.0	9.1
58	Worebabu	South Wello	466	266	112	89	57.1	23.9	19.0
59	Abergelie	Wag Himera	550	468	58	23	85.2	10.6	4.3
60	Dahena	Wag Himera	1,162	964	118	80	82.9	10.2	6.9
61	Gazgibela	Wag Himera	1,162	964	118	80	82.9	10.2	6.9
62	Sehala	Wag Himera	550	468	58	23	85.2	10.6	4.3
63	Seqota	Wag Himera	550	468	58	23	85.2	10.6	4.3
64	Zequala	Wag Himera	550	468	58	23	85.2	10.6	4.3
Average			939	688	159	92	73.2	17.0	9.9

* Kiremt: Main Rainy Season from June to September, which correspond to Meher

** Belg: Small Rainy Season from March to May

*** Bega: Dry Season from October to February

(Source: Data processed from Data of National Meteorological Agency)

Table 3.5.3 Elevation Range in the 64 Woredas

No.	Woreda	Zone	Elevation (m)				Ratio by Elevation Range(%)				
			Mean	Highest (a)	Lowest (b)	Range (a-b)	Kolla	Weyna Dega	Dega	Wurch	High Wurch
1	Enebse Sar Mider	East Gojam	2,008	3,535	1,150	2,385	12.0	61.0	25.4	1.6	0.0
2	Goncha Siso Enese	East Gojam	2,253	3,506	1,249	2,257	3.9	43.3	51.7	1.2	0.0
3	Shebele Berenta	East Gojam	1,837	2,479	1,032	1,447	27.0	51.0	21.9	0.0	0.0
4	Adarekaye	North Gonder	1,628	4,395	863	3,532	51.4	38.2	8.3	1.6	0.5
5	Beyeda	North Gonder	2,804	4,448	1,280	3,168	1.5	32.4	29.1	25.3	11.6
6	Dabat	North Gonder	1,915	2,992	972	2,020	23.9	44.3	31.8	0.0	0.0
7	Debark	North Gonder	2,000	4,069	983	3,086	28.6	43.2	22.5	4.1	1.5
8	East Belesa	North Gonder	1,710	2,612	1,204	1,408	12.4	86.9	0.7	0.0	0.0
9	Janamora	North Gonder	2,539	4,511	1,189	3,322	7.3	36.1	34.1	14.2	8.2
10	Telemt	North Gonder	2,064	4,378	955	3,423	25.8	41.4	25.4	4.6	2.8
11	West Belesa	North Gonder	1,902	3,164	1,472	1,692	0.3	94.9	4.9	0.0	0.0
12	Wogera	North Gonder	2,172	3,076	1,081	1,995	6.9	49.0	44.1	0.0	0.0
13	Angolelana Tera	North Shewa	2,745	3,092	1,663	1,429	0.0	9.9	90.1	0.0	0.0
14	Asagirt	North Shewa	2,300	3,570	1,116	2,454	13.0	39.6	39.6	7.8	0.0
15	Gishe Rabele	North Shewa	2,669	3,548	1,830	1,718	0.0	20.3	74.7	5.0	0.0
16	Menze Gera Mider	North Shewa	2,923	3,562	1,663	1,899	0.0	6.7	69.7	23.6	0.0
17	Menze Lalo Mider	North Shewa	2,571	3,187	1,567	1,620	0.0	24.9	75.1	0.0	0.0
18	Menze Mama Mider	North Shewa	2,708	3,407	1,590	1,817	0.0	16.4	77.2	6.4	0.0
19	Menze Qeya	North Shewa	2,287	2,915	1,468	1,447	0.5	49.3	50.2	0.0	0.0
20	Bugena	North Wello	1,986	2,827	1,336	1,491	1.5	82.3	16.2	0.0	0.0
21	Dawunt	North Wello	2,099	2,801	1,337	1,464	6.1	60.0	33.9	0.0	0.0
22	Delanta	North Wello	2,711	3,785	1,506	2,279	0.0	29.4	48.2	21.7	0.7
23	Gidan	North Wello	2,880	4,101	1,745	2,356	0.0	8.8	63.6	25.9	1.7
24	Guba Lafto	North Wello	2,587	3,804	1,353	2,451	4.2	34.3	33.8	27.0	0.8
25	Habru	North Wello	1,465	3,301	905	2,396	55.9	41.6	2.5	0.0	0.0
26	Kobo	North Wello	1,806	3,049	1,011	2,038	28.4	60.4	11.2	0.0	0.0
27	Lasta	North Wello	2,446	4,238	1,539	2,699	0.0	56.7	29.7	9.5	4.0
28	Mekete	North Wello	2,344	3,461	1,455	2,006	0.2	56.5	34.9	8.4	0.0
29	Wadela	North Wello	2,815	3,381	1,522	1,859	0.0	16.6	72.1	11.4	0.0
30	Artuma Fursi	Oromiya	1,222	2,152	571	1,581	76.8	23.2	0.0	0.0	0.0
31	Bati	Oromiya	1,335	2,215	891	1,324	74.6	25.4	0.0	0.0	0.0
32	Dewa Chefa	Oromiya	1,744	3,270	1,184	2,086	26.2	69.0	4.7	0.1	0.0
33	Dewa Harewa	Oromiya	1,358	2,346	893	1,453	74.4	25.6	0.0	0.0	0.0
34	Jilena Timuga	Oromiya	1,321	1,889	849	1,040	86.1	13.9	0.0	0.0	0.0
35	Ebinate	South Gonder	2,002	3,204	1,237	1,967	5.3	76.2	18.5	0.0	0.0
36	Laye Gayint	South Gonder	2,420	4,108	1,371	2,737	1.1	47.3	44.3	6.1	1.2
37	Libo Kemkem	South Gonder	2,163	3,164	1,783	1,381	0.0	68.3	31.7	0.0	0.0
38	Simada	South Gonder	2,069	3,289	1,203	2,086	7.2	59.7	32.9	0.1	0.0
39	Tach Gayint	South Gonder	2,154	3,437	1,317	2,120	2.5	64.2	32.1	1.2	0.0
40	Alebuko	South Wello	2,568	3,156	1,730	1,426	0.0	14.9	85.1	0.0	0.0
41	Ambassel	South Wello	2,476	3,651	1,439	2,212	0.5	35.8	57.1	6.6	0.0
42	Aregoba Special	South Wello	1,500	2,373	1,015	1,358	54.2	45.6	0.2	0.0	0.0
43	Debre Sina	South Wello	2,233	3,706	1,132	2,574	9.0	41.7	47.1	2.2	0.0
44	Dessie Zuria	South Wello	2,838	3,826	1,654	2,172	0.0	13.2	60.8	25.1	0.9
45	Jamma	South Wello	2,364	2,759	1,448	1,311	0.1	35.0	64.8	0.0	0.0
46	Kalu	South Wello	1,860	2,845	1,221	1,624	8.5	83.8	7.7	0.0	0.0
47	Kelela	South Wello	2,021	2,968	1,236	1,732	5.7	70.9	23.4	0.0	0.0
48	Kuta Ber	South Wello	2,513	3,461	1,736	1,725	0.0	32.1	65.7	2.2	0.0
49	Legambo	South Wello	3,076	4,114	1,984	2,130	0.0	1.4	58.5	36.6	3.6
50	Legehida	South Wello	2,524	3,363	1,672	1,691	0.0	30.5	67.8	1.7	0.0
51	Mehal Sayint	South Wello	2,149	3,645	1,175	2,470	9.9	51.9	35.4	2.9	0.0
52	Mekedela	South Wello	2,345	4,218	1,281	2,937	2.6	50.4	40.8	5.2	1.0
53	Sayint	South Wello	2,353	4,257	1,192	3,065	6.1	48.7	31.1	11.4	2.6
54	Tehulederie	South Wello	2,058	2,911	1,315	1,596	4.1	72.1	23.8	0.0	0.0
55	Tenta	South Wello	2,660	4,200	1,540	2,660	0.0	35.1	46.0	15.0	3.9
56	Wogedi	South Wello	1,922	2,836	1,097	1,739	12.1	66.5	21.4	0.0	0.0
57	Wore Illu	South Wello	2,651	3,595	1,658	1,937	0.0	14.1	83.0	2.8	0.0
58	Worebabu	South Wello	1,546	2,818	927	1,891	51.5	42.6	5.9	0.0	0.0
59	Abergelie	Wag Himera	1,467	2,366	1,008	1,358	59.9	40.1	0.0	0.0	0.0
60	Dahena	Wag Himera	1,929	3,131	1,207	1,924	5.8	84.7	9.4	0.0	0.0
61	Gazgibela	Wag Himera	2,480	3,867	1,720	2,147	0.0	36.1	59.0	4.8	0.2
62	Sehala	Wag Himera	1,542	2,914	1,060	1,854	49.6	48.8	1.5	0.0	0.0
63	Seqota	Wag Himera	1,954	3,098	1,250	1,848	2.8	91.8	5.4	0.0	0.0
64	Zequala	Wag Himera	1,621	2,410	1,051	1,359	33.8	66.1	0.1	0.0	0.0
Average			2,166	3,324	1,298	2,026	15.3	44.7	34.2	5.1	0.7

Kolla: 500-1,500 m Weyna Dega: 1,500-2,300 m Dega: 2,300-3,200 m Wurch: 3,200-3,700 m High Wurch: >3,700 m

(Source: Data processed from SRTM-3, Shuttle Radar Topography Mission (SRTM))

(4) Categorization of 64 Woredas by Natural Environment

By using annual rainfall and elevation as criteria, the 64 Woredas are categorized into six agro-climatic zones as shown below. The most common zone is Moist Weyna Dega, which includes 19 Woredas, followed by 17 of Moist Dega, 13 of Dry Weyna Dega and others.

Table 3.5.4 Categorization of the 64 Woredas by Natural Environment

Agro-climatic Zone		Annual Rainfall (mm)	
		Less than 900 (Dry)	900 - 1400 (Moist)
Elevation (m)	2300 - 3200 (Dega)	Dry Dega (5 Woredas) Gidan, Goncha Siso Enese, Gishe Rabele, Menze Gera Mider and Debre Sina	Moist Dega (17 Woredas) Legambo, Angolelana Tera, Asagirt, Menze Lalo Mider, Menze Mama Mider, Menze Qeya Gebriel, Delanta, Wadela, Alebuko, Ambassel, Dessie Zuria, Jamma, Kuta Ber, Legehida, Tenta, Wore Illu and Gazgibela
	1500 - 2300 (Weyna Dega)	Dry Weyna Dega (13 Woredas) Bugena, Kobo, Enebse Sar Mider, Shebele Berenta, Beyeda, Janamora, Telemt, Dawunt, Dewa Chefa, Mehal Sayint, Wogedi, Seqota and Zequala	Moist Weyna Dega (19 Woredas) Ebinate, Simada, Mekedela, Dabat, Debark, East Belesa, West Belesa, Wogera, Guba Lafto, Lasta, Mekete, Laye Gayint, Libo Kemkem, Tach Gayint, Kalu, Kelela, Sayint, Tehulederie and Dahena
	500 - 1500 (Kolla)	Dry Kolla (6 Woredas) Aregoba, Bati, Dewa Harewa, Worebabu, Abergelie and Sehala	Moist Kolla (4 Woredas) Adarekaye, Habru, Artuma Fursi and Jilena Timuga

However, in most cases, a Woreda includes a wide range of elevation and rainfall. Because the weighted-average elevation of Woredas is calculated as 2,026 m, a Woreda consists of 3.5 traditional agro-climatic zones. In the case of Debark Woreda, for example, the most dominant zone is Weyna Dega accounting for 43.2 % of the total area while it includes other four zones such as 28.6 % of Kolla, 22.5 % of Dega, 4.1 % of Wurch and 1.5 % of High Wurch. Furthermore, in Asagirt Woreda, the percentage of the area under Weyna Dega and Dega zones are almost the same; 39.55 % and 39.64 % are Weyna Dega and Dega zones respectively. That is, even though the 64 Woredas can be classified into six categories according to the agro-climatic zones, this result should be utilized with understanding of this point.

(5) Categorization of 64 Woredas by Natural Environment and Road Networks

Numbers of analyses by deferent aspects and views were conducted in the Study. The obtained and processed data were examined as parameters for strength of correlation: rainfall, rainfall, slope, soil type, temperature, runoff, lad cover, vegetation, and etc. As a result of the analyses, it was found that road network density has correlation with green development in the Study Area according to satellite information of the last two and half decades as follows.

1) Human Activities

Dozens numbers of reforestation activities have been carried out in ANRS during the last two and half decades. Those activities have not been evaluated appropriately. It is observed that some areas in ANRS have significant forest increase. It is also said that deforestation is a result of human activities: however, reforestation is also a result of human activities at positive side, thus human

activity is one of important factors to research and analyze on reforestation.

2) Change of Landcover Composition

Though the details of satellite image analysis are described in the section 3.4, a pie chart is picked up and shown below.

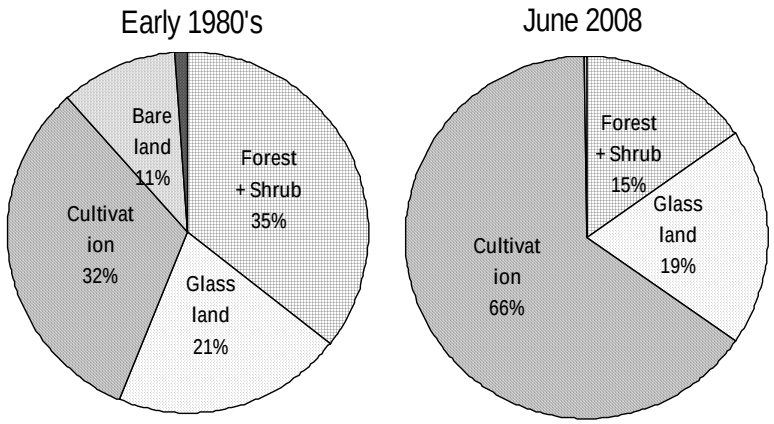


Figure 3.5.1 Changes of Landcover Composition in the 64 Woredas from early 1980s to 2008

As mentioned before, drastic change of landcover composition can be recognized in Figure 3.5.1: the coverage of forest and shrubs in the 64 Woredas decreased from 35% down to only 15%, but cultivation area increased from 32% up to 66% by contrast. The results imply that reforestation activities in the last two and half decades seem to be not so successful: however, the different viewpoint can give another idea on reforestation.

3) Road Network Effect on Reforestation / Deforestation

Again, by using the same satellite image analysis results, reforested areas and deforested areas are visualized; the land-cover composition change image from 1980s to 2008, and then, road network in the region is overlaid on the image. The result is shown in Figure 3.5.2. The reforested area (the area of green color) exactly corresponds with trunk road networks in the region, which the roads have been developed and upgraded in the last two and half decades: such as Addis Ababa – Dessie, Addis Ababa – Bahir Dar, and the area around Gondar. The roads, being recently developed, seem to have less reforested area: such as Bahir Dar – Gayint – Weldia: however, green-belt will develop along such roads near future because tree growth takes long time.

Usually, road construction gives a negative impact against natural environment but the result of this analysis implies different stories and tendencies: east part of ANRS had been developed in early time, then, the most of forest trees had been cut and forest exposed bare land. Under such circumstances, adverse affect on forests by trunk roads was quite limited because there were not so many trees in the forest. In contrast, the trunk roads could provide positive impacts on reforestation by: material transportation function (seeds, seedlings, fertilizers, pesticides, herbicides, etc), information dissemination function (awareness of importance of; forest, forest conservation, family planning, technical information through human resources, market information etc).

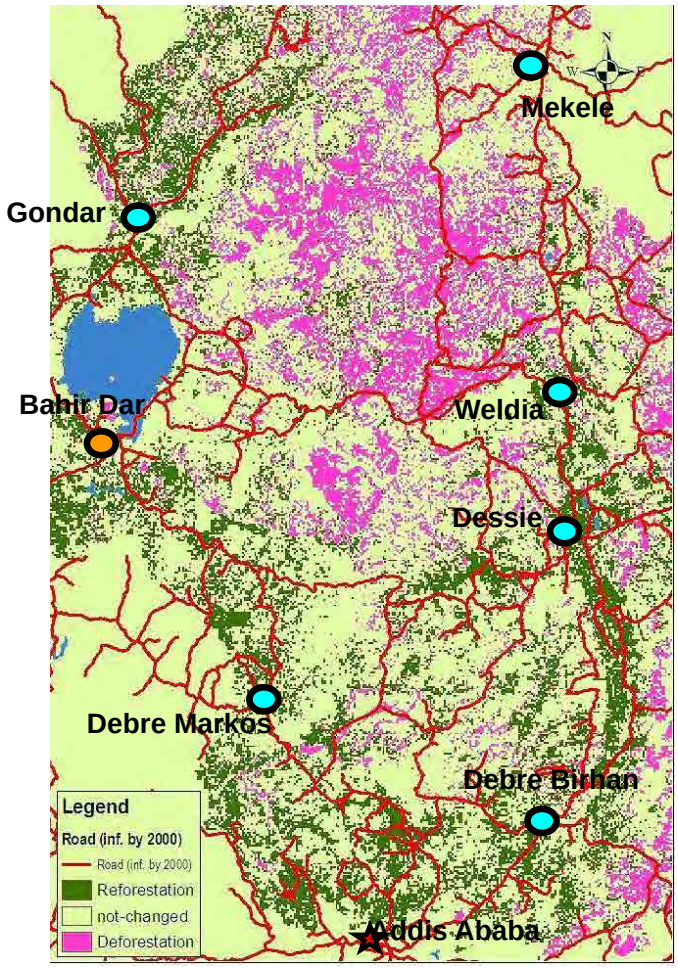


Figure 3.5.2 Reforested Area and Deforested Area from early 1980s to 2008

On the other hand, deforested areas (the area of red color) can also be seen in Figure 3.5.2: the area of the Takeze (At Bara) basin in the northern part and the Awash basin at the eastern part have deforested during the last two and half decades. These areas have annual rainfall of around 900mm or less, and are located at the northern side of a mountain ridgeline Ras Guna - Amor Abar Plain.

Wet air comes from south-west side and provides rain mostly before reaching Ras Guna – Amor Abar Plain or around there. This is why annual rainfall at the northern side of Ras Guna – Amor Abar Plain is not so much. Not only less rainfall but also poor road network might cause these areas to be deteriorated.

There is one area at the southern side of Ras Guna - Amor Abar Plain where it is a deforested area. This eastern part of Simada has no significant road networks up to the recent days so the deforestation pressure may be higher than effect of reforestation.

4) Reforestation Potential

Annual rain fall of 900mm may be one of indicators to classify the area of ANRS into potentials between reforestation and deforestation. Figure 3.5.3 shows a relationship between reforestation

potential index[18] and composite parameter[19] of road density/annual rainfall in the 64 Woredas. The correlation coefficient is r = 0.554, and it has a significant correlation with 1% significant level. It can be said that road density and annual rainfall have some correlationship with reforestation / deforestation potential in the 64 Woredas.

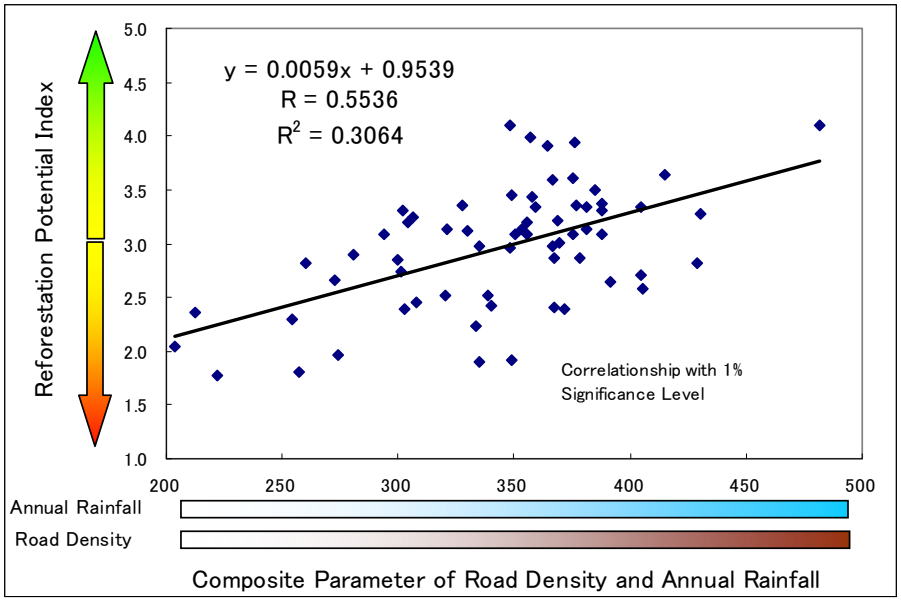


Figure 3.5.3 Relationship between Road Density/Annual Rainfall and Reforestation Condition in the 64 Woredas

(Data source: Study Team, BoFED Baseline Survey 2003/04, and modified by the Study Team)

5) Categorization

Some hints are obtained from aforementioned analysis: categorization of the 64 Woredas was made and the results are shown in Figure 3.5.4 and Figure 3.5.5 by pattern diagrams. Figure 3.5.4 shows present situation of the 64 Woredas and Figure 3.5.5 shows future situation of the 64 Woredas. In the Figures, vertical direction of triangle shows a mode elevation of a Woreda. Different colors indicate Kolla, Weyna Dega, and Dega. Left and right of triangle show annual rain fall potential of a Woreda: the left side is less than 900mm, the right side is more than 900mm. A Woreda locates near the center axis of triangle shows that the Woreda has much road net work; A Woreda at distant side from the center axis means that the Woreda has less road network. Future situation is created based on a construction plan obtained from the Amhara Rural Road Authority and some predictions of the Study Team.

[18] Reforestation potential index is formulated as follows: (reforested area by % of a Woreda; 1980's -- 2008) X 4 + (conserved area by % of a Woreda; 1980's -- 2008)X3 + (deforested area by % of a Woreda; 1980's -- 2008).

[19] Composite parameter is formulated as follows: 0.4X(estimated annual rainfall in mm of a Woreda)^0.96 + (total road density of a Woreda)^0.95

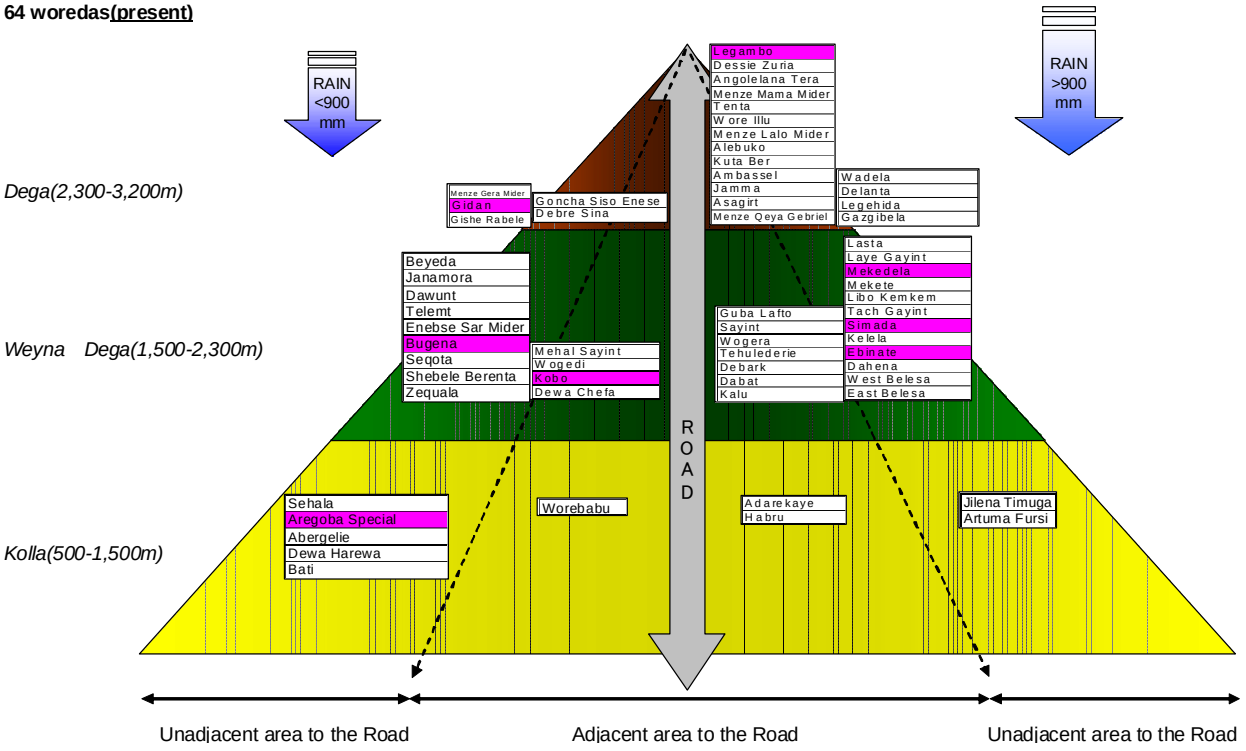


Figure 3.5.4 Pattern Diagram of the 64 Woredas Categorized by Vicinity of Trunk Road and Annual Rainfall under Present Condition

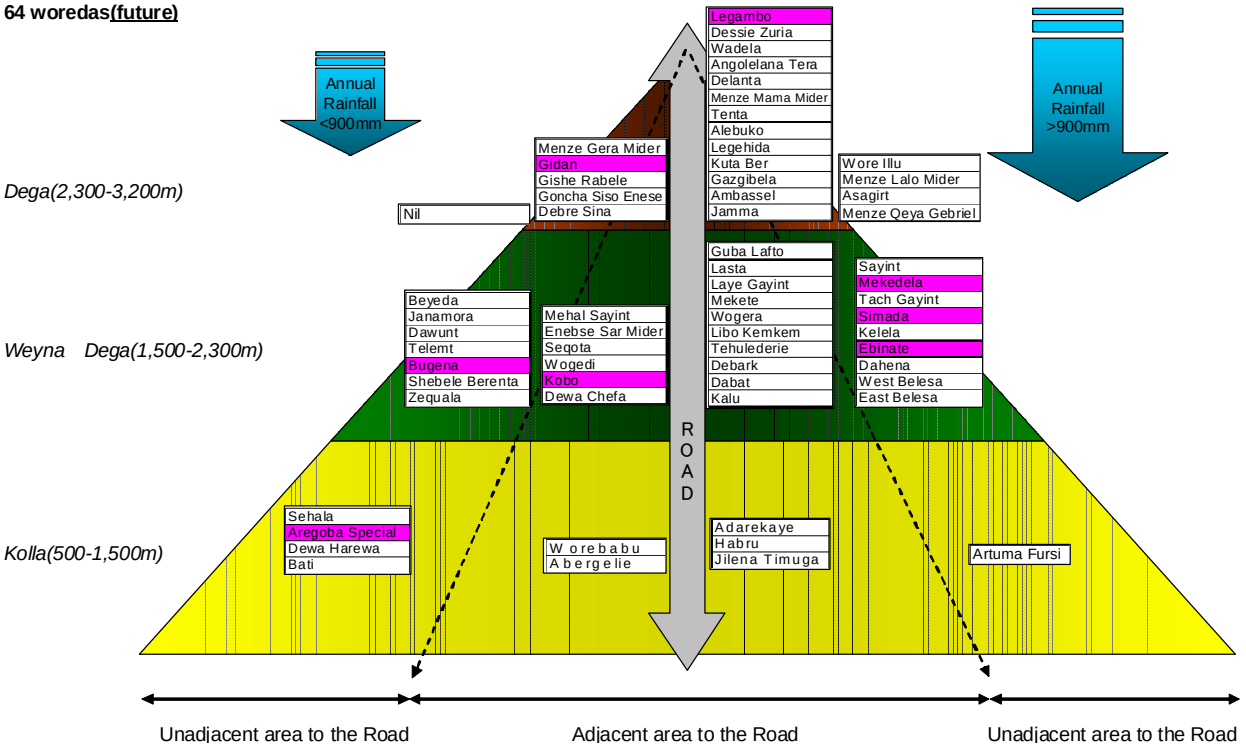


Figure 3.5.5 Pattern Diagram of the 64 Woredas Categorized by Vicinity of Trunk Road and Annual Rainfall under Expected Future Condition