FEATURES AND ISSUES RELATED TO THE ETHIOPIAN BIOMASS ENERGY SECTOR

REGIONAL STATES OF ETHIOPIA
MAJOR RELIEF OF ETHIOPIA

POPULATION

- POPULATION: 67 MILLION
- 90 PERCENT ARE RURAL:
THE HIGHLANDS

- HIGHLANDS (OVER 1,500masl)
  - COVER 43 % OF COUNTRY
  - 88 PERCENT OF POPULATION
  - 95 % OF CULTIVATED LAND
  - 75 % OF LIVESTOCK
  - LONG HISTORY OF HUMAN SETTLEMENT

THE LOWLANDS

» LOWLANDS BELOW 1,500masl

» LOWLANDS IN THE EAST, SOUTHEAST AND SOUTH

- ANNUAL RAINFALL LESS THAN 600mm
- ACACIA SHRUBLAND TO DESERT
- TRANSHUMANT PASTORALISTS
- LOW POPULATION DENSITIES
LOWLAND IN THE SOUTHWEST AND WEST

• ANNUAL RAINFALL OVER 800mm
• COMBRETUM-TERMINALIA WOODLAND AND LOWLAND BAMBOO
• SHIFTING CULTIVATORS
• TRYPANOSOMIASIS AND MALARIA
• LOW POPULATION DENSITIES

THE WOODY BIOMASS INVENTORY AND STRATEGIC PLANNING PROJECT

• IDENTIFIED 1984 WB/UNDP ENERGY SECTOR STUDY
• PHASE I – 1989 TO 1995 25 % OF COUNTRY
• BRIDGING PHASE 1996 – 1998
• PHASE II – 1999 – 2003 – 75 % OF COUNTRY
• "REGIONAL" APPROACH
• NINE STRATEGIC PLANS AND INVESTMENT PROGRAMMES
• BEING IMPLEMENTED UNDER "ACCESS TO ENERGY PROJECT"
WOODY BIOMASS ENERGY SECTOR

- COMPRISSES:
  - MAJOR SOURCES: WOOD, CHARCOAL, CROP RESIDUES, ANIMAL DUNG
  - MINOR SOURCES: SAW DUST, BAGASSE

- USERS:
  - 94% RURAL AND URBAN HOUSEHOLDS
  - 6% COMMERCIAL SERVICES, COTTAGE INDUSTRIES, INDUSTRY

HOUSEHOLD BIOMASS ENERGY CONSUMPTION PATTERNS

- FUELWOOD: 45.7 MILLION TONS (78% OF ENERGY)
- CHARCOAL: 0.25 MILLION TONS (1% OF ENERGY)
- RESIDUES: 5.2 MILLION TONS (9% OF ENERGY)
- DUNG: 8.8 MILLION TONS (12% OF ENERGY)
- "MODERN" ENERGY CONTRIBUTES ONLY 1% OF HOUSEHOLDS ENERGY CONSUMPTION
BIOMASS ENERGY SUPPLY PATTERNS

- STANDING STOCK 939 MILLION TONS (1,565 MILLION M³)
- ANNUAL INCREMENT 45 MILLION TONS (75 MILLION M³)
- DEAD WOOD USED AS FUEL 8 MILLION TONS (14 MILLION M³)
- 0.8 MILLION TONS (1.3 MILLION M³) OF WOOD FROM AGRICULTURAL CLEARING
- CROP RESIDUES 24 MILLION TONS
- DUNG 27 MILLION TONS

NATIONAL WOODY BIOMASS SUPPLY - CONSUMPTION BALANCES

- TOTAL WOOD CONSUMPTION = 47.6 MILLION TONS (79.4 MILLION M³)
  (PLUS CHARCOAL) CONSUMPTION
  (EXCLUDING INDUSTRY)
- ANNUAL INCREMENT = 45 MILLION TONS (75 MILLION M³)
- DEAD WOOD = 8.4 MILLION TONS (14 MILLION M³)
- AGRICULTURAL CLEARING = 0.8 MILLION TONS (1.3 MILLION M³)
THE PROBLEM IS LOCAL NOT NATIONAL

- OUT OF 482 WEREDAS SURVEYED 336 WEREDAS ARE CONSUMING MORE THAN THEIR WOODY BIOMASS ANNUAL INCREMENT

- MOST OVER-CONSUMING WEREDAS LOCATED IN THE HIGHLANDS

TRENDS IN WOODY BIOMASS SUPPLY

- PRIOR TO 1991:

  • PROHIBITION ON TREE CUTTING
  • FREQUENT RE-ALLOCATION OF FARM PLOTS TO ACCOMADATE NEW FAMILIES
  • STRONG FEELING OF LAND AND TREE TENURE INSECURITY
  • NO INVESTMENT IN TREE PLANTING BY FARMERS
POST 1991:
- LIFTING OF BAN ON TREE CUTTING
- FORMAL ACKNOWLEDGEMENT OF INDIVIDUAL TREE TENURE AND FREEDOM OF DISPOSAL
- MASSIVE INCREASE IN DEMAND FOR CONSTRUCTION POLES AS ECONOMY TAKES OFF
- BIG INCREASE IN ON-FARM TREE PLANTING (EUCALYPTUS) FOR POLES
- FUELWOOD A BY-PRODUCT
- RATE OF PLANTING RELATED TO PROXIMITY TO ROADS AND MARKETS

TRENDS IN BIOMASS FUELS CONSUMPTION

- RURAL HOUSEHOLDS
  - INCREASE IN USE OF WOOD FUEL
  - DECREASE IN USE OF DUNG RELATED TO:
    - (INCREASE IN WOOD SUPPLY)
    - (ELIMINATION OF FERTILIZER SUBSIDIES AND INCREASE IN FERTILIZER PRICE - INCREASE IN PERCEIVED VALUE OF DUNG)
– URBAN HOUSEHOLDS

• INCREASE IN USE OF ELECTRICITY DUE TO EXPANSION OF CONNECTIONS

• INCREASE IN THE USE OF CHARCOAL DUE TO REDUCTION OF CONTROLS ON CHARCOAL TRADING

• DECREASE IN THE USE OF WOOD FUEL DUE TO FUEL SUBSTITUTION

• INCREASE IN USE OF KEROSENE DUE TO BETTER DISTRIBUTION

PART 2

• ISSUES RELATED TO CONSUMPTION AND SUPPLY OF BIOMASS FUELS IN ETHIOPIA
1. INTEGRATED NATURE OF BIOMASS FUEL SUPPLY AND LAND USE SYSTEMS IN ETHIOPIA

- Wood, residues and dung come from the farm

- Residues: value as livestock feed
  - 1.825 tons of residues feed one tropical livestock unit (competition for on-farm resources)

- Dung: value as soil nutrients
  - 1 ton dung 16 kg of nitrogen: 16 kg of nitrogen increase crop yield by 96 kg
  (competition for on-farm resources)

2. FUELWOOD SUPPLY AND PRODUCTION OF CONSTRUCTION POLES

- Farmers plant trees for poles not fuelwood

- Fuelwood is a by-product

- Implication for biomass energy planning
  - Must consider demand and supply of construction poles
3. FUELWOOD COLLECTION NOT RESPONSIBLE FOR DEFORRESTATION

- IN THE FOREST AREAS:
  - CLEARING FOR AGRICULTURE MOST IMPORTANT FACTOR IN DESTRUCTION OF HIGH FOREST
- IN WOODLAND AREAS
  - SHIFTING CULTIVATION AND INCREASING POPULATION PRESSURE AND SHORTENING OF TREE FALLOWS
  - CLEARING FOR LARGE SCALE AGRICULTURE

4. BURNING OF DUNG AND CROP RESIDUES AS FUEL AND SOIL NUTRIENT DEPLETION

- ESTIMATED 44,000TONS OF NITROGEN LOST
- ESTIMATED 18,000TONS OF PHOSPHOROUS LOST
- CROP PRODUCTION FOREGONE IS 271,000 TONS OF GRAIN
- 3 % OF ETHIOPIA’S TOTAL ANNUAL GRAIN PRODUCTION
- ENOUGH TO FEED OVER 1 MILLION PEOPLE FOR A YEAR
5. POTENTIALS FOR INCREASING BIOMASS ENERGY AND END USE EFFICIENCY

• URBAN HOUSEHOLDS
  • 90% ENERGY EXPENDED ON COOKING
  • VERY SUCCESSFUL DISSEMINATION OF TWO STOVES UNDER PRIVATE ENTERPRISE:
    - “MIRT” STOVE FOR “MITAD” BAKING
    - “LEKECH” CHARCOAL STOVE
  • BUT - RECENT ELECTRICITY TARIF INCREASES STOPPED ADOPTION AND USE OF ELECTRIC “MITAD” STOVE

• RURAL HOUSEHOLDS
  • RURAL HOUSEHOLDS DO NOT USE CHARCOAL (NO DEMAND FOR “LAKECH” STOVE
  • RURAL INCOMES VERY LOW
  • RURAL MARKETS FOR “MIRT” STOVE VERY THIN,
  • NO INCENTIVES FOR “MIRT” STOVE MAKERS TO GO INTO RURAL AREAS OR SMALL TOWNS
METHODOLOGY
LAND COVER MAPPING

• VISUAL INTERPRETATION OF 1:250,000 LANDSAT TM COLOUR COMPOSITE FOLLOWED BY GROUND AND AERIAL FIELD CHECKS

• TRANSFER LANDCOVER MAPPING UNITS TO 1:250,000 TOPOGRAPHIC SHEETS AND DIGITIZE INTO COMPUTERIZED GEOGRAPHICAL INFORMATION SYSTEM

• USING UNSUPERVISED CLASSIFICATION OF LANDSAT TM DIGITAL RESOLVE INTO 15 – 20 CLUSTERS

• WITHIN EACH MAPPING UNIT INTERPRET EACH CLUSTER AND ASSIGN TO SPECIFIC LAND COVER TYPE

• FIELD VERIFICATION OF INTERPRETED CLUSTERS

• FINAL REVISION AND PRODUCTION OF LAND COVER MAP

METHODOLOGY
WOODY BIOMASS INVENTORY

• WOODY BIOMASS STOCK:

  • DETERMINE NUMBER OF SAMPLE PLOTS AND TRANSECTS REQUIRED FOR EACH LAND COVER TYPE IN EACH AGRO-ECOLOGICAL ZONE

  • IN GIS RANDOMLY LOCATE START POINTS OF EACH TRANSECT AND RANDOMLY SELECT COMPASS BREARING

  • LOCATE TRANSECT START POINT IN FIELD: MEASURE STEM DIAMETER ALL WOODY STEMS > 10CMS IN MAIN PLOTS; ALL WOODY STEMS IN SUB PLOTS

  • FOR REPRESENTTATIVE SUB SAMPLE OF TREES CUT AND WEIGH ALL WOODY BIOMASS AND DETERMINE MOISTURE CONTENT
• UNDERTAKE REGRESSION ANALYSIS BY SPECIES BY AGRO-ECOLOGICAL ZONE TO DETERMINE WEIGHT – STEM DIAMETER RELATIONSHIPS

• DETERMINE TOTAL WOODY BIOMASS PER HECTARE BY LAND COVER TYPE BY AGRO-ECOLOGICAL ZONE AFTER CONVERTING TO OVEN DRY WEIGHT

• WOODY BIOMASS YIELD

• SELECT REPRESENTATIVE TREES BY SPECIES BY AGRO-ECOLOGICAL ZONE

• ACCURATELY MEASURE STEM DIAMETER AT BREAST HEIGHT (dbh) – 1.3 METERS

• RE-VISIT AND MEASURE DBH OVER AS MANY YEARS AS POSSIBLE AT SAME TIME OF YEAR USING SAME TECHNICIAN WHERE POSSIBLE

• FOR SUB-SAMPLE CUT MARIAUX WINDOW IN CAMBIAN. FELL AND CUT DISC TWO YEARS LATER AND COMPARE RING GROWTH WITH RAINFALL RECORDS
• FROM DISCS CUT DURING WEIGHING OPERATION DETERMINE WHERE POSSIBLE THE NUMBER OF RINGS AND COMPARE WITH DBH

• FROM REPEATED STEM MEASUREMENTS AND FROM RING COUNTS DETERMINE ANNUAL INCREMENT

METHODOLOGY
SOCIO-ECONOMIC SURVEY

• DETERMINE NUMBER OF SAMPLE HOUSEHOLDS PER REGION AND ASSIGN TO FARMING SYSTEMS BASED ON PROPORTIONAL TO POPULATION IN FARMING SYSTEM AREA

• RANDOMLY ASSIGN HOUSEHOLDS TO SPECIFIC WEREDAS AND TO SPECIFIC FARMERS ASSOCIATIONS

• APPLY HOUSEHOLD QUESTIONNAIRES TO SAMPLE HOUSEHOLDS

• APPLY QUESTIONNAIRES TO COMMUNITY FOCUSED GROUP, TO REPRESENTATIVE WOMEN’S GROUP, TO F.A. OFFICIALS, TO WEREDA OFFICIALS

• CODE AND ENTER DATA INTO COMPUTER PROGRAMME (MS ACCESS)

• PRODUCE REQUIRED TABLES

• PRODUCE FINAL REPORT