# Project on Air Pollution in the context of Ethiopia based on Kaizen philosophy

## Forwarded Message -----

**From: berhanu tadesse <berhanutat@yahoo.com>**
**Sent: Thursday, 27 December 2012, 6:33**
**Subject: letter from UNESCO/UNEVOC**


## Berhanu Tadesse Taye


**Amended in Feb 2015**

**Addis Ababa Ethiopia**

## *Abstract*

The purpose of the study project proposal is to assess Air Pollution in the context of Ethiopia. I want to share my views on the problem that the country has faced and on some of the practical remedial approaches to the problem at hand and designed this mini project for the purpose of obtains funding from donors. I am enthusiastic to lend a hand with by providing innovative practical training based on Kaizen philosophy for individuals formulating them in to micro and small enterprises and entrepreneurs on reduction of air pollution and family planning even at rural area.

Ethiopia identified major gaps in the national effort to reduce vulnerability in one of the area of Wag Himra zone Ziqualla Woreda on food insecurity, environmental degradation and embark on a path of sustainable development. High population growth rate combined with backward technologies results in undue pressure on natural resources and lead to chronic vulnerability. The main types of degradation considered are deforestation, traditionally using animal dang for cooking and "*Kuraze"* for lighting which results brought by this is soil erosion and pasture problems. The goal of this mini project is to contribute to the reduction of air pollution through better understanding of it and related things which aggravate the issues. Since the profile that female-headed households are more vulnerable to food insecurity and exposed to pollute themselves by household activities. These practices of utilization, in unsustainable manner, have obviously accelerated the deforestation rate resulting in the environmental degradation, climate change, and decline in the soil fertility.

So, if you have something about my shared ideas, please lend me your views in your 'utopian universe'. We can do something by sharing our ideas with each other thereby reducing air pollution better than before. In summary, we can reduce the amount of carbon emission into the air by supplying modern cooking device (i.e. *mitad*), solar device and Small Scale Bio-Gas Production for every rural and urban areas. Therefore, we can increase our technological beneficiaries, transforming traditional ways of living into modern ways of living. Due to this fact, since the world is dynamic we shall improve our curriculum at the TVET Colleges in the country to be responsive to the societal and economical problems. The quality of life in the woreda is low as indicated lack of using technological equipment and the increasing crude population density.

Since we are rich in terms of Sun shine we should have to use it as a sour of energy by making or buying the device solar at household level. The project's general goal is to contribute to the sustainable development and utilization of the natural resources of the country. The project included the practical production training manual which has scientific description of fuel saving stoves by using materials mold cast..., production raw materials including installation of the last production of mirt stove and how to use it properly, In 1998 E.C or in 2005 G.C, Save the Children United Kingdom (SC UK) attested the researcher by writing a letter of accreditation and vivid clarification about the letter of accreditation, UNESCO-UNEVOC official invitation, Picture of Old (traditional) and modern cooking devices used for baking Injera and its impact and healthy production of new devices, also this mini research includes readers' comments on the theme. Strongly recommend that, Implement effective and efficient policy interventions encourage invention and innovation for urban and rural areas support and strive for proper utilization of affordable and appropriate technological equipment for the farmers.

# Tables of content

# 1. *Project on Air Pollution in the context of Ethiopia*

## 1.1. *Introduction*

Dear readers, first of all, I would like to extend my greetings from the bottom of my heart to those of you who have already got convinced on the previous pieces of information on air pollution at different levels. On my opinion, we can reduce air pollution by making concerted efforts at different levels to contribute to this timely and multifaceted issue anywhere in the globe. In 1977, the Food and Agriculture organization (FAO) and UNESCO jointly published an alarming map of the spread of desertification across the world. I am enthusiastic to lend a hand with by providing innovative training for individuals formulating them in to micro and small enterprises and entrepreneurs on Reduction of Air Pollution and family planning Micro-Level for concerned bodies. Ethiopia identified major gaps in the national effort to reduce vulnerability to food insecurity, environmental degradation and embark on a path of sustainable development. High population growth rate combined with backward technologies (without using technology) results in undue pressure on natural resources and lead to chronic vulnerability. The main types of degradation considered are deforestation which results brought by this is soil erosion and pasture problems.

Currently, I am a student at Graduate Programme of Vocational Business Management in Addis Ababa University (A.A.U.) in Ethiopia. I want to share my views on the problem that the country has faced and on some of the practical remedial approaches to the problem at hand and designed this mini project for the purpose of obtains funding from donors. In our country context air pollution is also severely affecting human health due to lack of information on the theme. One of the major factors for this problem is the use of traditional cooking system and "Kuraze" meaning kerosene lamp for lighting purpose during the night time, especially in rural and limited urban areas in the country.

The goal of this mini project is to contribute to the reduction of air pollution through better understanding of it and related things which aggravate the issues. Since the profile that female-headed households are more vulnerable to food insecurity and exposed to pollute themselves in household activities. The outcome of these activities is expected to help improve the designed and implementation of response packages that address the underlying cause of desertification and bring sustainable development through using modern technological equipment. Indeed, Ethiopians' contribution to the problematic issue under consideration to world is very minimal. However, the major causes for air pollution in the world are carbon emission, utilization of fuel based energy, industrial smoke and chemicals, rapid population explosion on one hand nature itself like volcanic eruption, earthquake etc. affect nature in the other hand which contributes environmental pollution. There could be no more graphic expression of the ecological dangers that threaten so much food production, so many livelihoods in the developing countries etc.

# 2. A Short Account on Agricultural Natural Resources in the World

In 1977, the Food and Agriculture Organization (FAO) and United Nations Educational, Science and Cultural Organization (UNESCO) jointly published an alarming map of the spread of deserts across the world. Shaded in orange, pink and red were all the area in danger of desertification. The coloured patches covered a major part of the developing world outside

the rainy equatorial belt. In Latin America they covered north-east Brazil, central and northern Mexico and stretched right down the Andes as far as Chile. They ate into the Horn of Africa and much of the south west of the continent. And without interruption they reached half way round the global in a broad swathe North Africa and the Sahara, right across and Persia to Pakistan and north-west India

According to United Nation Environmental Programme (UNEP) report (1977) the world is losing precious agricultural land at twice the rate that new land is being broken for farming. Due to deforestation an area bigger than former Great Britain is disappearing every year. Soil is being exhausted, eroded, and blown away at the rate of two and a half billion tons per year. By the end of the century the world may have to support one and a half times its present population on only three quarters of its present cultivated area.

In his report on the state of the environment in 1977, United Nations Environment programme Director, Mostafa Tolba, warned that, if present trends continue, there would be only 0.15 hectares of farm land per person by the year 2000, half the 1975 level. Productivity would have to double merely to allow people to get the same amount of food as today. These are the figures on which he based that calculation: in 1975 there were 1,240 million hectares under cultivation. Over the next twenty-five years, perhaps another 300 million new hectares may be opened up. But over the same period 600 million hectares-half the entire 1975 cultivation area – may be lost of this, half will probably disappear under the ink-blot. Spread of cities, which are expanding horizontally twice as fast as their populations are growing, and over some of the best agricultural land at that. The other 300 million will be the toll of soil degradation.

At least half of the total erosion will be in the world's 45 million square kilometres of potentially productive but ecologically precarious dry lands, which stretch through a hundred nations. About 700 million people live in this zone, almost all of them in developing countries, and 80 million live in areas that are currently undergoing rapid desertification.

Everywhere the deserts are advancing. In Sudan the southern edge of the Sahara moved south by 100 kilometres between 1958 and 1975. The deserts don't march forward on a solid front, like an army. Patches appear, like those at Aorema in Burkina Faso, around centres of population or watering holes, then spread, link up with others, and finally merge into the desert itself.

The chief agent of what has been called leprosy of the soil is man, the impact of his activities on highly sensitive and delicately balanced ecosystems. The prime factor in the process is population increase. The number of people in the Sahel, for example, is doubling everywhere the consequences of this among settled farmers: the cultivating down of fallow periods, a progressive decline in the vegetation cover, increasing erosion. As population goes on growing, cultivation is pushed into areas that are entirely unsuitable for agriculture, and there the process progresses even more rapidly.

The pastoral nomads and their animals are the other protagonists in the tragedy. Their populations have been increasing too, a little more slowly than the farmers, but too, fast for the land. Four or five head of cattle are required to maintain person, so this automatically means an increase in the livestock numbers. But other factors have expanded the herds beyond the limits of good sense. Improved breeding and veterinary services have cut down

the great epidemics that kept herds in check. Pastoralists are not noted for rational herd management. The animals are their wealth, their status symbols, and their insurance policies. In years of good rainfall they expand their stocks to insure against drought: but it is a policy that does not payoff. As they start to cull the herds in dry years, meat prices may fall, so they are reluctant to reduce numbers enough. Gradually far more animals build up than the system can maintain, and it breaks down under the strain.

In addition to farming and herding, there is a third factor in the spread of man-made deserts: deforestation. The progressive destruction of the third world's stock of trees is damaging not only in dry regions: everywhere it occurs it can reduce its capacity to feed and employ people. It can reduce that does fall runs off into rivers and streams, taking topsoil with it. This leads to silting downstream, the dilapidation of irrigation systems and an increase in floods.

The world's forests are shrinking at an alarming rate. It has been estimated that between 1900 and 1965 perhaps half the forest area in developing countries was cleared for cultivation. The 935 million hectares of closed tropical forest still left may be disappearing at the rate of 1.5 % to 2 % a year unless careful management policies are introduced, this could lead to their total disappearance within fifty or sixty years. Studies from individual countries confirm the overall picture. In the hilly Azuero peninsula of panama, more than two fifths of the forest was removed between 1954 and 1972. In Brazil, a quarter of forestry reserves had been cut down by 1974. In 1975 Brazil's forest were being cleared at the rate of 62,000 square miles a year. If continued, this would destroy the Amazon forest, believed to provide a quarter of the world's oxygen supplies, in just twenty seven years. Comparison of aerial photographs of the Ivory Coast taken in 1956 and 1966 showed that nearly a third of the forest cover has disappeared in those ten years. By the mid-seven-ties only five million hectares of forest remained of the fifteen million that the Ivory Coast had at the beginning of the century. Many of the disappearing forests are being cut down for firewood. The FAO estimates that some 86% of wood cut in the developing countries is used for fuel. A total of 1,220 million cubic metres goes up in smoking every year, about half a cubic metre, or a medium-sized tree, for every person.

Wood is an inefficient source of energy, especially when burned on traditional open fires: up to 94 percent of its heat value is wasted. It is a poor fuel, yet the poor have no alternative to it. Kerosene is too expensive, especially after the oil price rises, and you have to buy costly equipment to burn supplies dwindled and people have to trek further and further from the villages to get a load. In Nepal, where it used to take an hour or two at the most, collecting wood is now a whole day's labour. As all available trees near centres of population are stripped Labourers in Niamey, Niger, are reportedly spending one quarter of their incomes on wood. This predicament is what environmental writer, Erik Eckholm, has called the poor man's energy crisis.

## 3. A Short Account on Agricultural Natural Resources in Ethiopia

In our country context air pollution is also severely affecting nature as a whole. One of the major factors for this problem is the use of traditional cooking system and "Kuraze" meaning kerosene lamp for lighting purpose during the night time, especially in rural and limited urban areas in the country.

## 3.1. Introduction

According to GTZ, Natural resources can broadly be divided into Renewable and Non-renewable. Whereas the non-renewable include such resources as minerals, which cannot replenish themselves once used, the renewable include plants, animals, soil, water and the atmosphere, which do replenish themselves.

In addition to its economical significance, forest-a renewable resource plays a key role for ecological balance and environmental sustainability in general. Thus, the misuse of the resource has not only its economical implication but also influences the environmental security surrounding humanity. The destruction of forests negatively affects soil erosion, climate change (local and global), agricultural productivity as well as poverty and the environment in general.

Traditionally, wood fuel claims the largest proportion of biomass fuels (in some regions up to 90%) used in developing countries, where about 40% of the total wood cut annually is used for domestic purposes (cooking and heating). Estimating an average per capita consumption of 3 kg of wood per day for energy (cooking, heating and boiling water) in rural areas in Asia and Africa, the daily per capita demand of energy equals about 13 kWh which could be covered by about 2 m3 of biogas. A biogas plant therefore directly saves forest, assuming that not only deadwood is collected for fuel. Without any effective political measures, the problem of deforestation and soil erosion will become more and more critical. As the population increases the consumption of firewood will increase more steeply. Without biogas the problem of deforestation and soil erosion will steadily become more critical as firewood consumption rises relative to higher density of population. The demand for nourishment also raises accordingly, which means that constant extension of agricultural land increases at the expense of forested areas.

## 3.2. Asset, non-farm income and coping strategies

If household have sufficient wealth, they can by food in the market and their access to food would not be very sensitive to fluctuation in their own production. These factors are important because the risky income may not be total income. They may have secure labor income or remittance. Because they are concerned with fluctuations of total income rather than solely agricultural income, calculation of vulnerability has to be done with respect to total income. The lower the share of the risky income in total income, the lower the vulnerability of a given household. Thus, an account of vulnerability should include (I) availability of off farm employment opportunities and income, obtained from them, (II) type and value of assets owned, and (III) access to common property resources and community support mechanism. Ability to accumulate wealth and off-farm income opportunities depends on community-level variables (such as location vis-à-vis urban/ marketing centers and credit institution) and household-level variables (such as skill, availability of seed money, and access to credit.

Coping strategies very spatially and at community, social class, household, gender, age and seasonal level. The types of strategies employed by households also vary depending on the severity and duration of strategies employed by households also vary depending on the

severity and duration of the disruptive conditions and their use as an indicator is location specific. Hence, coping strategies can be important guides in designing and implementing modern machinery used, food security policy, and during selection of households as the poor have lower to assistance and other coping mechanism.

## 3.3. **Ethiopia's Forest Resource Situation**

According to GTZ farther added that, it is believed that more than 60% of the country's soil used to be covered with High Forest, Savannah Woodland and Bush land forests before the last couples of centuries. However, due to the unwise utilization and destruction sustained for the last several decades, the coverage declined to 40% in the turn of the 19th century. It further declined to 16% in the beginning of the 1960's. Due to the increased economical, social and political activities following the change of government in 1974, the situation worsened and in the late 70's the resource was found further dwindled to3.5%. Currently, the coverage is estimated at a mere 2.7% since the destruction is ever worsening. It is therefore evident that less emphasis is given to the protection and development of the resource in the country. For the majority of the society, the importance of the resource in respect of the aforementioned benefits has yet to come into the picture. Still, we are in a situation where almost everybody has free access to the resource as a means of income. It is therefore implied that the general awareness by the society towards forest and its importance is minimal.

The causes of the destruction of forests in Ethiopia are several and complex: the increase for the need of arable and grazing land, expansion of towns and new settlements, and the increase in the firewood demand as well as materials for construction are some of the main. These, mixed with the ever increase in the population, exacerbate the situation further and especially the resulting soil erosion forced smallholding farming households move to areas already affected by soil erosion.

Except some sporadic endeavours, however, extensive and prudent measures towards solving the problem are yet to be taken. On the contrary, the practice today is that more forested areas are being cleared in search of new cultivable lands to compensate for the decline in agricultural productivity.

The majority of the population uses firewood as a source of household fuel. Moreover, raw materials for such applications as building construction, household furniture manufacturing, animal feedstock, etc all come directly or indirectly from the forest. These practices of utilization, in unsustainable manner, have obviously accelerated the deforestation rate resulting in the environmental degradation, climate change, and decline in the soil fertility and agricultural productivity, which led ultimately to desertification, the impact of which have been eventually affecting the livelihood of the people.

The following are among the basic factors inherent to the problems surrounding the forest resource of the country:

- Lack of policy addressing forest and land use issues
- Increase in the population of both inhabitants as well as animals
- Lack of awareness of the public for the protection and development of forest
- Lack of strong institutional framework vested with the responsibility of developing and administrating the forest resources of the nation

In sum, we are in a situation locked with several problems surrounding our forest resource base.

1. The two universal solutions for alleviating the problems, agreed up on by many scholars and professionals in the field, are: Utilization of the existing resource in a sustainable way and
2. Afforestation measures to increase the level of the resource base

On the other hand, it has already been mentioned that the majority of the population is utilizing firewood and agricultural remains as their main sources of fuel.

Since the last couples of decades, the government of Ethiopia has implemented successful measures for the dissemination of improved stoves in a bid to promote the efficient utilization of fuel. With the same cause, the MoARD/GTZ-Sustainable Utilization of the Natural Resources for Improved Food Security-Energy (GTZ-SUN: Energy) project is currently implemented by the Federal Ministry of Agriculture and Rural Development and the German Technical Cooperation (GTZ).

## *3.4. Rapid population growth*

For example when we see the most venerable area it shows high population growth rate combined with backward technologies results I undue pressure on natural resources and lead to chronic vulnerability. Population growth rate in Ziqualla between 1994/95-1998/99 was 2.8 percent. During this period, agricultural density of the woreda, defined as persons per square-kilometer of cultivated land, increased from 170 to 193.

Amhara National regional state commission of for Disaster prevention and preparedness, (2002) study result on Participations of community group discussion asserted that family size and the number of farming households is rising. Population growth is identified as a major factor behind over-utilization of land, environmental stress (deforestation and erosion), and migration in search of livelihoods in other areas. Under these conditions, limiting births is indispensable in curbing the ever-increasing population pressure. Unfortunately, availability and utilization of family planning services is very low. Moreover, only 7 percent of key informants advocate continuous availability and utilization of these services. Hence much wok needed to alleviate the attitudinal problems of the farmer.

## 3.5. **The GTZ-SUN: Energy project**

The project's general goal is to contribute to the sustainable development and utilization of the natural resources of the country. With these goals, the project intervenes to meeting the following main objectives:

- Catalyze the developments of the energy resources, especially Renewable Energy

(RE) resources and technologies, to promote rational use of natural resources, poverty reduction and food security

- Enhance the capacity of the different partner government agencies and other stakeholders to integrate and execute energy development measures into their development programs

- Promote energy efficiency at all levels (especially the efficient use of biomass resources at the households)

The project embarks on the following strategies towards hitting its goal and meeting its objectives:

- Undertake capacity building measures for the different stakeholders in developing strategies for, and implementation of energy development measures
- Promote strong participation of the private sector in the development and provision of energy services
- Promote the awareness about, and the adoption of different environment friendly energy technologies and measures
- Actively promote the awareness of decision makers and the general public on environment and energy issues

The project's strategy regarding the promotion of Mirt improved Injera baking stove include:

- Focus on the commercial dissemination of the stove
- Involving the private sector, through the formation of small holding stove production and sales enterprises, for the commercial dissemination of the stove
- Promote and support the decentralized production and dissemination of the stove
- Close cooperation with government and non-government agencies

The project has commenced its activities in 1998 and has since established more than 350 private stove production facilities in more than 200 towns in Amhara, Tigray, Oromia and Southern Nations Nationalities and Peoples' regions.

Moreover, the project has been closely cooperating with different agencies, institutions and organizations to promote and disseminate the stove all over the nation.

## 3.6. Fuel Saving Stoves

## 3.7. Introduction

Energy from fire has long been used in activities such as cooking, which require energy. In addition, especially in the ancient civilizations, fire served as a typical means of protection against predator animals. Then, the sources of energy serving the purpose were mainly from plants that are known, by their collective name, as Biomass Fuels.

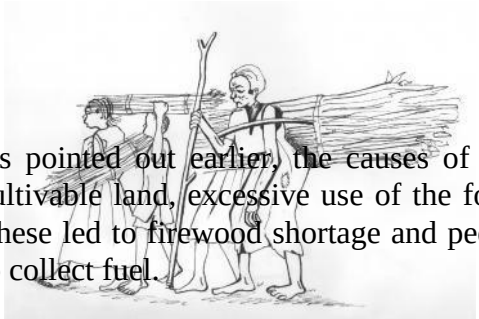
Energy is an indispensable part of every civilization. However, according to the level of civilization, different sources of energy are utilized. Mineral fuels such as gasoline and gasoil have been used to run locomotives and different machinery whereas to produce electricity, hydropower, solar energy, wind and coal have been used.

Food, being a necessity for life, has to be cooked before serving. For this purpose, different forms of energy such as electricity, gasoline, natural gas and coal, as well as biomass are

being used. From all these, the share of biomass energy, worldwide, is significant and about 80% of the planet's population depend on this resource for their daily livelihood. The picture is never different in our country where about 95% of the energy demand is satisfied by the utilization of these sources.

The direct burning of biomass fuels in the traditional way emits partially burnt gases, which are harmful to human respiratory and visual systems. This is not only dangerous to women and the accompanying children usually exposed to these gases but is also wastage in terms of fuel utilization as the energy that could otherwise be obtained from burning them, is lost. Moreover, fire hazard associated with the three-stone open fire is among the common household problem especially in the rural Ethiopia.

Currently, in some areas of Ethiopia, households are forced to expend 30 to 40% of their income on cooking fuels. In the areas where fuel is acquired through free collection from the jungles, women and children responsible for the duty have to travel 5 to 6 hours in search of fuel.



As pointed out earlier, the causes of the problem are the clearing of forests in search of cultivable land, excessive use of the forest resource for construction and fuel purposes, etc. These led to firewood shortage and people have to travel farther away from their residences to collect fuel.

In addition, the country has long been suffering from recurrent droughts and erratic rainfall. Since the agricultural remains and animal dropping outs are used as fuel, the soil fertility is declining very fast. The loss of soil fertility is not, however, remedied by chemical fertilizers and consequently the agricultural productivity is very much low.

In an effort to alleviate the problem, though only partially, fuel use efficiency at household level is one of several measures that need to be taken. It is well known that the three-stone open fire, which is common all over the nation, is a very inefficient way of cooking, from energy utilization point of view. Only 8-10% of the heat goes to cooking the food where as more than 90% of the heat is simply wasted.

In this article, a brief account on fuel characteristics with due emphasis on firewood, the combustion phenomenon and process, heat transfer mechanisms, heat dissipation mechanisms from stoves and the methods to minimize it are presented. Finally, it is discussed about mirt stove, all its features, how it is produced, in more detail.

## 3.8. How Do Fuels Burn?

For it is the most relevant fuel in this context, let's take the case of firewood to investigate the combustion phenomenon.

Typically, wood consists of cellulose, lignin-a compound of carbon and hydrogen, resin and water together with gum bases. To fire wood, oxygen is needed in addition to the minimum amount of heat energy to start the combustion process. When burning wood, the source of oxygen is atmospheric air. Atmospheric air is 79% nitrogen gas and almost 21% oxygen. In any combustion process, the amount of oxygen being supplied plays a crucial role. Whenever there is enough oxygen, the wood burns well, with less smoke.

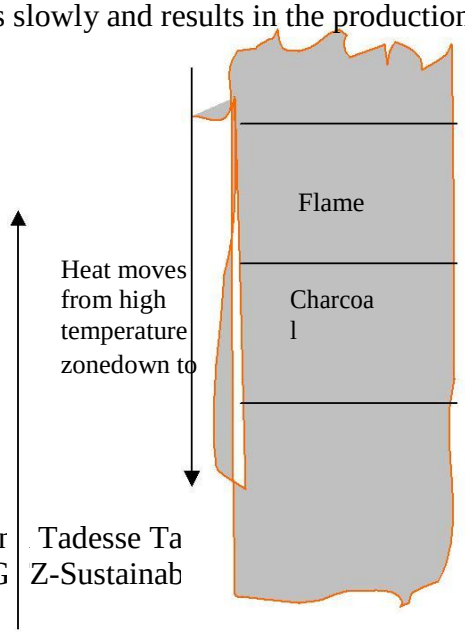
In the early stage of the combustion of wood, water and carbon dioxide come out of the wood and begin to cover its exterior. This shielding prevents the contact of the wood from oxygen and consequently smoke is emitted.

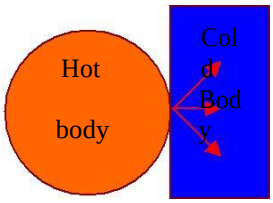
However when the combustion progresses, the amount of the heat of combustion increases resulting in the evaporation of the water and in the evolving of combustible gases and liquid tar like compound from the interior of the wood. More gases come out when the liquid tar is heated with the already carbonized wood. Finally, the chemical reaction of the emitted gases with oxygen produces chemical compounds that we see as flame.

For combustion, every combustible gas requires its own minimum amount of temperature and oxygen. In closed stoves if more than required amount of oxygen enters the stove, the extra amount of air robs some of the heat of combustion on its way leaving the system. Also, if the speed of incoming air is more than necessary, then it will be difficult to attain enough temperature in the stove that would otherwise progress the combustion. Nor is it possible to have a good combustion in the stove if the amount of incoming air is less than the required.

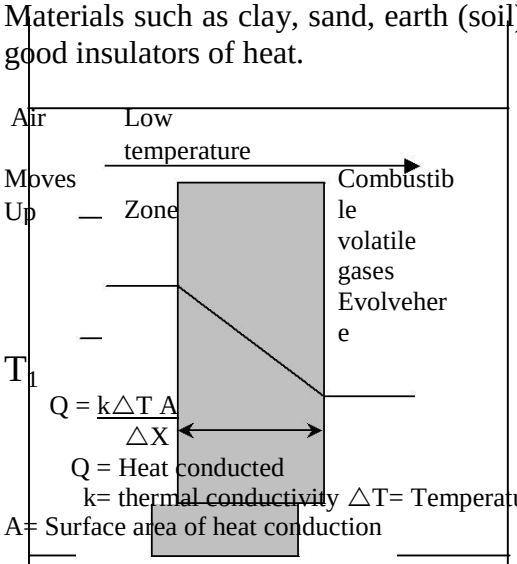
Once the situation of good combustion is attained in the system, all the combustible gases will come out of the wood and burn further developing the process. Eventually, carbon monoxide and nitrogen begin to burn and the
carbonized wood gives off heat burning as charcoal.

When the combustion occurs very fast, the production of liquid tar and combustible gases will be very fast which produces more heat in a relatively short period. Here the produced charcoal is relatively smaller. On the contrary, when the air supply is small the combustion occurs slowly and results in the production of more charcoal.






The amount and the rate of the transferred heat depend on the heat conduction characteristics, expressed as the thermal conductivity, of the two bodies. Some materials are good conductors of heat but others are not. Materials such as steel and basalt are good conductors of heat. Materials such as clay, sand, earth (soil) as well as wood and sponge, are poor conductors or good insulators of heat.




$$Q = \frac{k \triangle T A}{\triangle X}$$

Q = Heat conducted

k= thermal conductivity △T= Temperature difference △X= Distance of heat conduction

A= Surface area of heat conduction

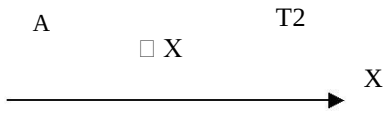
## 3.9. Heat Transfer

The three modes of heat transfer that occur in nature are:

a. Conduction
b. Convection and
c. Radiation

### 3.9.1. Conduction

Heat transfer, by conduction, occurs by virtue of temperature difference in the direction from the body of higher temperature to that of lower temperature. This transfer will continue until a state,




$$Q = \frac{k \square T A}{\square X}$$

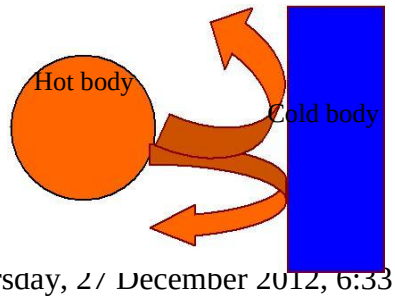
Q = Heat conducted

k= thermal conductivity □ T= Temperature difference□ □ X= Distance of heat conduction

A= Surface area of heat conduction

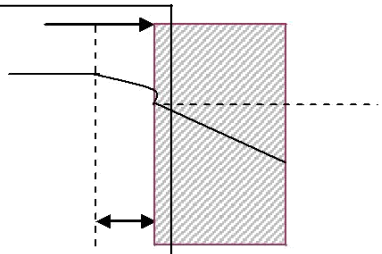
### 3.9.2. Convection

called thermal equilibrium, is reached at which the two bodies are at the same temperature.



To understand the transfer of heat by convection, let's consider a certain liquid in a metal container whose bottom is exposed to a source of heat.

Under a state of high temperature, molecules of gases and liquids (collectively known as fluids) rise against the pull of gravity. This movement induces the movement of colder molecules in the downward direction. This continuous motion will keep on so long as the heat is being supplied and every molecule of the fluid is at the same temperature. The resulting motion is circulation in which hotter molecules move upwards and colder molecules move downwards. This dynamics of material transport effects the distribution (i.e. the transfer) of heat, which we call convection, in the fluids.



$Q = hA\Delta T$
h= convective heat transfer coefficient
A= heat transfer area
$\Delta T$ = Temperature difference

To understand the transfer of heat by convection, let's consider a certain liquid in a metal container whose bottom is exposed to a source of heat.
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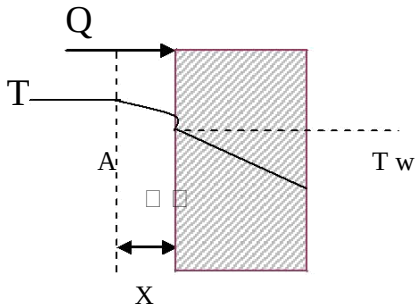
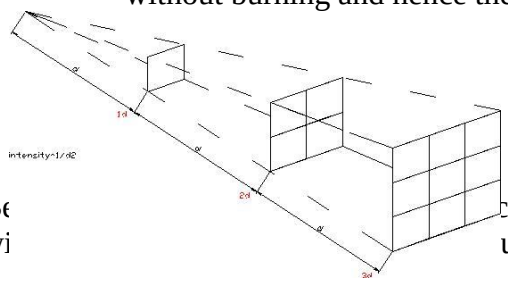



Q = hA□ T
h= convective heat transfer coefficient A= heat transfer area
□ T = Temperature difference

3.10. **Radioactive heat transfer**

without burning and hence the heat thatcould otherwise be obtained is lost.

In general, the following are the main mechanisms of heat loss from stoves:



$$E_{T2} \square \frac{E_{T2}}{d^2}$$

ET1 =source radiation intensity
ET2 =radiation intensity at distance
d d= distance from the radiation source

## 3.11. Heat Leakage from Stoves

As already pointed out, the heat leakage from three-stone open fire is unmatched. Heat is lost through convection and radiation from the three stones, since their temperature is very high. Since the 'stove' is not closed, the hot gases burn and simply leave the system without heating the cooking pot (or *mitad* (plate) in the case of baking). The combustible gases may even leave the stove without burning, making the fuel wastage even worse. This phenomenon is observed as dark smoke coming out of the stove.

The common clay stoves in use also have problems. Their clay walls are thin and heat can be lost easily through that. Since the size of the stoves itself is not properly designed, the amount of air flowing and fuel put into them is not proportional. This makes the combustible gases escape the stove without burning and hence the heat that could otherwise be obtained is lost. In general, the following are the main mechanisms of heat loss from stoves:

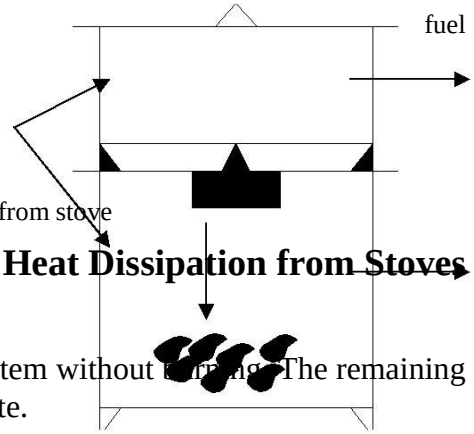
1 Unburned fuel

Total available heat

4 Heat absorbed by pot and stove

3 Heat dissipate from pot

2 Heat dissipated from stove



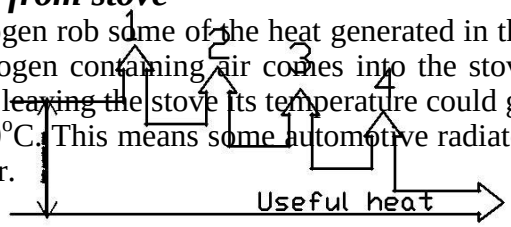
**Mechanisms of Heat Dissipation from Stoves**

### *1. Incomplete combustion*

Some of the emitted gases from the fuel leave the system without burning. The remaining fuel left unburned as charcoal, is considered also waste.

### *2. Heat loss due to loss of hot flue gases from stove*

The inert parts in the incoming air such as nitrogen rob some of the heat generated in the stove on their way leaving the stove. The nitrogen containing air comes into the stove with a lower temperature, say 23 $^{o}$C. But, when leaving the stove its temperature could go as high as 400 to 500$^{o}$C but never less than 250$^{o}$C. This means some automotive radiator and the cooling of hot pot by the surrounding air.




## 3.12. Radiation

A good example of such energy transfer is the sun's radiation coming to our planet.

No matter small it may be, every material radiates heat energy as long as its temperature is above -273.15 $^{o}$C. Materials that intercept the radiation reflect part of the energy while they absorb some of it. Some of the energy could also be transferred to other bodies, by either one or the combination of the other modes of heat transfer.

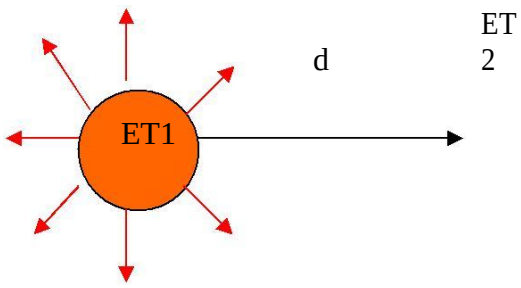
Radiation cannot be recognized with naked eye when emitted and transferred at lower

temperatures. But, it becomes more visible when the temperature increases. When burning, wood gives off a flame radiating a lot of energy.

$Q = \square \; F_e F_A (T_1^4 - T_2^4)$

$\square$ = Stefan Boltzmann's constant ($5.7 \times 10^8$)
$F_e$= Emissivity coefficent $F_A$= View factor $T_1$=Temperature of body 1 $T_2$= Temperature of body 2

Another instance of convective heat transfer is when a fluid is forced to flow over a hot/or cold solid surface.




According to whether the fluid is hotter or colder than the solid, heat is transferred from the fluid or to the solid, respectively, by convection. Such kind of convection is called forced/or active convection. Examples of Active convection include, cooling of water in

of the heat is lost together with the smoke. In addition to this, the moisture of the firewood is given off from the stove in the form of vapor, which cannot be realized without stealing some of the heat of combustion.

## 3.13. *Heat loss due to absorption by the stove and cooking utensil*

During operation, before heating/cooking the food, the cooking utensils have themselves to be heated. Also the stove itself takes some of the heat of combustion. Since it is only then some of the heat transfers to the food, the remaining heat contained in the utensils and the stoves, is considered wasted.

**Heat absorbed by stoves and cooking utensils**
**$Q = mC\square T$**

**C** = Specific heat capacity **m** = Mass

$\square$ **T**= Temperature difference

**(Specific heat capacity (kJ/kg.K)**

| | |
|---|---|
| - Air | 0.1 |
| - Concrete | 1.0 |
| - Water | 4.189 |
| - Full wood | 1.8 |
| - Clay | 0.92-1.0 (depending on its Moisture content) |
| - Iron | 0.45-0.5 |
| - Aluminum | 0.9 |
| - Copper | 0.39 |

- Vermiculite 0.84-1.08 (Total condition)

environment, it is obvious that heat transfers by the three modes of heat transfer, from the stove to the surrounding environment.

The amount of heat energy needed to raise the temperature of 1 liter water from 20$^{o}$C to 100$^{o}$C is about 335kJ, whereas 2260kJ (more than 6 folds) of heat is required to evaporate the same amount of water at the same temperature of 100$^{o}$C.

### 3.14. *Heat loss from the cooking utensil to the surrounding environment*

By similar argument as in the case of the stove, heat transfers from the cooking utensils to the surrounding. In addition to that, heat of evaporation is one way of heat loss in *injera* baking, *wot* (sauce) cooking and water boiling, especially when there are not lids to cover the utensils*.

### 3.15. How can we minimize heat loss?

The strategies for minimizing heat loss from stoves are born from the causes of the problems of heat losses themselves. They are summarized as follows:

### 3.16. *Shielding the fire against ambient*

It has been already said that three-stone open fire is exposed from all its sides to the surrounding environment. This makes it easy to give off the heat of combustion especially by convection and radiation. Therefore, the obvious remedy is to shield the fire against the ambient. This not only decreases the heat loss by the aforementioned mechanisms but also minimizes the creation of smoke, as the peripheries of the flame will not be exposed to the lower surrounding temperatures that otherwise would cool the flame and inhibit the burning of the combustible gases evolving from the firewood.

### 3.17. *Heat loss from the stove parts to the surrounding environment*

During operation, since the stove is at higher temperature than the surrounding

* The amount of heat energy needed to raise the temperature of 1 liter water from 20$^{o}$C to 100$^{o}$C is about 335kJ, whereas 2260kJ (more than 6 folds) of heat is required to evaporate the same amount of water at the same temperature of 100$^{o}$C.

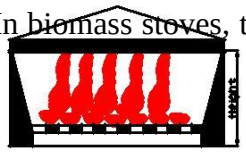
The selection of the proper material for the shielding plays significant role, as well. The common stoves with metal walls loose heat to the surrounding easily. However, such materials as earth, clay, concrete, cast iron are good insulators as they heat up slowly and do not give off heat fast either, thus can be considered as good candidates for shielding material.

### 3.18. *Regulating the incoming air streaming into the stove*

flame is not very far from the heat source, i.e. from the burning fuel. This is so because the most relevant heat transfer mechanism is either conduction (through physical contact) or radiation or both, which both need close distance. On the other hand, the combustible gases need space and time to heat up and eventually burn. This calls for the distance to be not very close.

#### 3.18.1. Heat transfer in stoves

In biomass stoves, the place where the wood burns is called firebox. For we have to obtain a



good combustion, we have to make sure that just enough air is reaching to the firebox. One strategy to do that is to design the stove air inlet so that it allows just enough amount of air into the stove.

Another important part of the stove in relation to this issue is the flue gas (smoke) exit. Stoves 'breath' (i.e. suck in fresh air and give out exhaust gases) on their own thanks to the pressure difference between their two extremes (i.e. air inlets and exhaust gas outlets). When the pressure difference is beyond

When the height is increased beyond the design value

**Conduction:** (from flame to the baking pan) decreases

**Convention:** (from hot gases in the stove to the baking pan) decreases

**Radiation:** (from the red-hot charcoal to the baking pan) decreases

When the stove wall is thin or made of conductive material

**Conduction:** (from flame and red-hot charcoal to the stove wall and to parts of the stove in contact with the wall) increases

**Convention:** (from hot gases in the stove to the stove wall and then to the ambient air) increases

**Radiation:** (from the red-hot charcoal to the stove wall and then to the ambient air) increases the requirement, more air comes in disrupting the proper combustion that would otherwise occur, just as mentioned earlier. The over-pressure situation may occur when, for example, the fuel outlet chimney is higher (in height) or wider (in area) than necessary.

### 3.18.2. *Sizing the fire box*

We have also to determine the proper distance between the fire bed and the cooking utensil to ensure maximum amount of heat being transferred to the utensil. To do this, we have to make sure that the utensil's part exposed to the

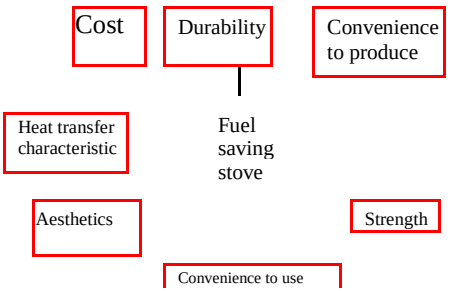
### 3.18.3. General Characteristics of Improved Stoves

The general criteria an improved stove has to fulfil are fuel saving, one that prevents the user from heat and fire hazards, one that is acceptable and affordable by the users. It has also to work on the fuel, which the users can normally afford.

### 3.19. Improved Stove

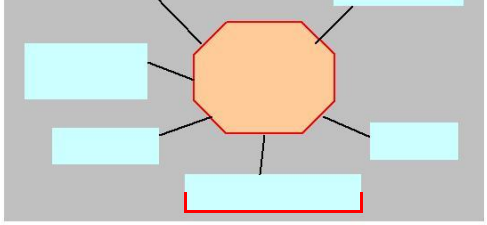
Like any other product, one has to consider many other elements, beyond heat characteristics, when designing an

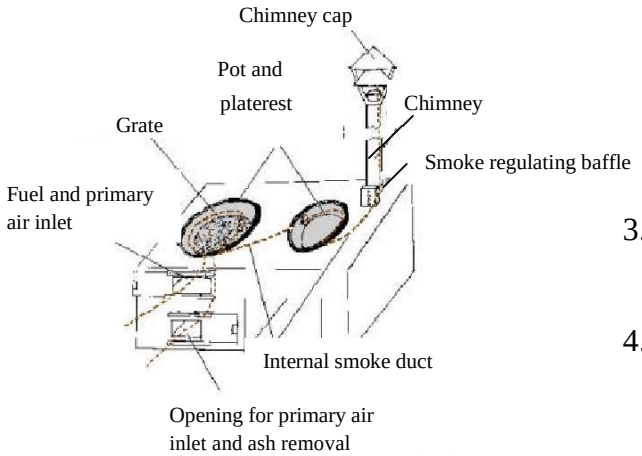
improved stove. The following pictorial Representation illustrates the problem one has to solve to provide an improved stove.

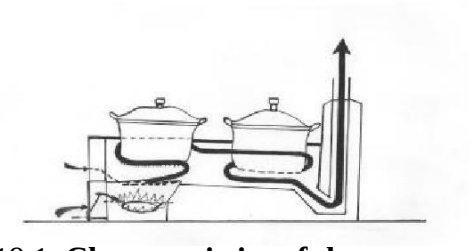



beneath and the secondary air, which burns the gases, comes into the stove from above the fuel. These are made possible through the two different doors; one is at the bottom and the other is at the top. Note that the top door also serves to put in fuel. We also see that there are control baffles used to regulate the incoming air flow.

2. The stove also features internal conduits usually made out of





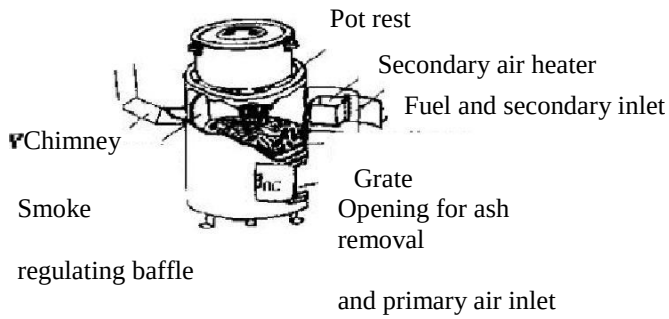



3.19.1. **Characteristics of the stove**

The stove depicted in the above figure can handle two pots at a time. In addition to the parts to serve the aforementioned purposes common to all improved stoves, it features some other units making the stove even better:

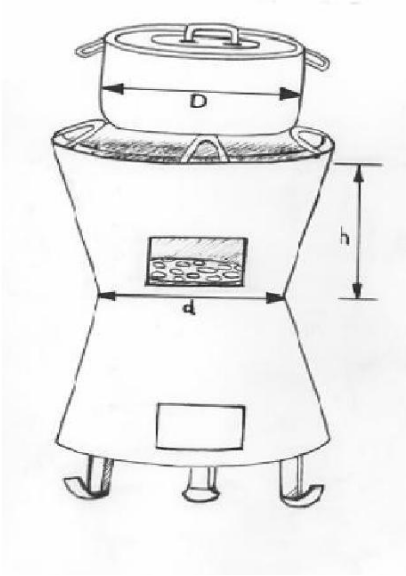
1. The combustible gases coming out of the burning wood make the flame while the solid part burns forming charcoal. Thus, the primary air, which burns the solid part (i.e. charcoal), comes into the stove from concrete or clay. Their purpose is to transport the exhaust gases while transferring their heat to the cooking pots on their way out. This effect is enhanced by making the conduits spiral around the pots, which creates more contact-area and -time between the conduits and the pots.
3. There are exhaust regulators around the exit of the stove just as there are on the inlet.
4. The caps fitted to the chimney can also be multiple. This is to alter the height of the chimney, in effect, to regulate the pressure difference between the inlet and the exit of the stove thereby regulating the incoming airflow according to the varying power needs.

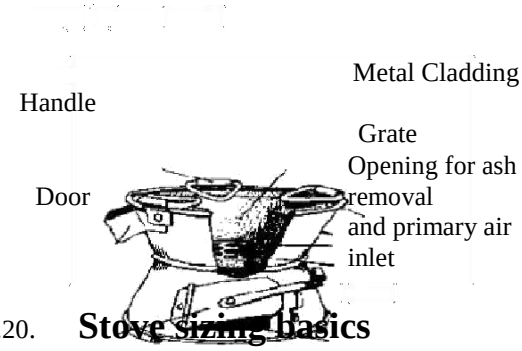
## 3.19.2. Hypothetical improved firewood stove design




**Improved Charcoal Stove**

Pot rest Ceramic combustion chamber






## 3.20. Stove sizing basics

The examples and descriptions so far illustrate the general characteristics that affect the fuel saving criterion of stoves and design considerations that should be kept in mind. Let's now see how we can determine the basic parts influencing the fuel saving characteristics of stoves.

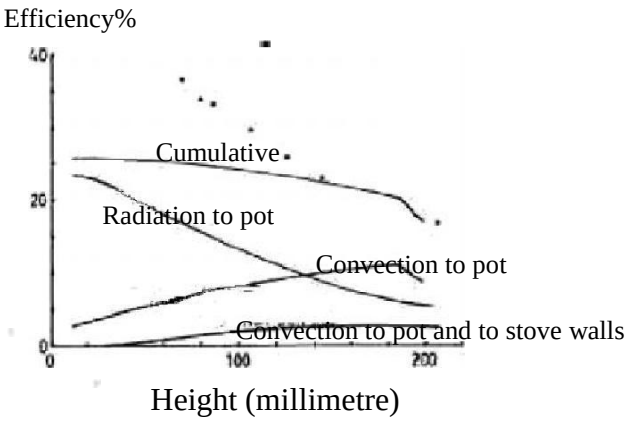
The following dimensions have been obtained from literature. They have been determined through extensive research and trials and therefore they can be used, at least, as the starting point to design different fuel stoves.

D= diameter of the pot (or any cooking utensil) on the stove

d= diameter of the fire bed

h= the height of the pot bottom from the fire bed

### 3.20.1. Relationship between height and heat transfer rate in stoves




The fire bed /grate/ in different wood stoves can be provided with perforations, which are used to filter down ash from the burning wood and let in primary air to the firebox. As can be seen from the figures, the fact that the fire bed is smaller in diameter than around the top gives more room and more time for the combustible gases to heat up and combust before they leave the stove. Further, the fuel is made to keep its central position in the stove, which is needed for uniform heat distribution in the stove. Another advantage is the lower cost of production material because of smaller physical size of smaller physical size of the grate.

## 3.20.2. **Fuel and Air Inlet**

It has already been mentioned that determining the proper size of the fuel and air inlet is an important part of the design of stoves.

Before going directly into it, however, we have to see some facts regarding the reacting substances-the fuel and the air:

- Typically, wood is composed of 50% carbon, 43% oxygen, 6% hydrogen and 1% ash. The fact that oxygen is available already in the wood in some amount makes the amount of external air needed small.
- To burn 1kg of firewood, the theoretical amount of air necessary is only $5m^3$. However, since the theoretical conditions are not available in practice (such as the fuel is split into smaller pieces and virtually every atom of carbon and hydrogen is contacted by that of the oxygen) more air, up to 40% extra is needed; hence a total of $7m^3$ is needed.
- The rate of airflow for a naturally aspirated stove (i.e. air flows into the stove without being blown) is about 1m/s.

Moreover, we have to know about the capacity of the stove we want to design:

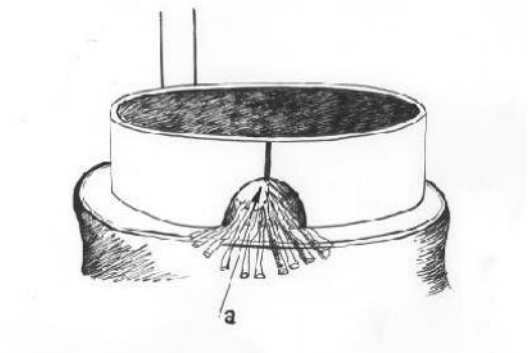
- A stove capable of burning 1kg of wood within an hour has about 5kW of power.

Knowing this we can determine the size of the air inlet, *a*, as:

$$a = \frac{amount\,of\,air}{Speed\,of\,air * time\,needed}$$

$$a = \frac{7m^3}{1m/s * 3600s} = 0.002m^2 = 20cm^2$$

The air inlet area for a 5kW power stove thus should not be too much different from $20cm^2$.




However, we have to determine the total size of air and fuel inlet, since both are usually put into the stove together. We have to employ a recommended ratio of fuel to air inlet areas to determine the area to be occupied by the fuel. Here we will assume that 70% of the total area will be occupied by fuel.

Thus, since we have already calculated the area of air inlet, to determine the total area of air and fuel inlet, *A*, we set, $a = 0.3 * A$ or

$$A = \frac{a}{0.3} = \frac{20cm^2}{0.3} = 67cm^2$$

This means that the area of the air and fuel inlet is about 8.5cm by 8.5cm It should be born in

mind that the calculations presented are only to show the methods of determination of the different sizes of the stove and in real life, the values may differ significantly from one stove to another depending on the specific cooking needs and fuels to be used.

### 3.20.3. Exhaust outlet area

The following should be in mind to determine the exhaust area:

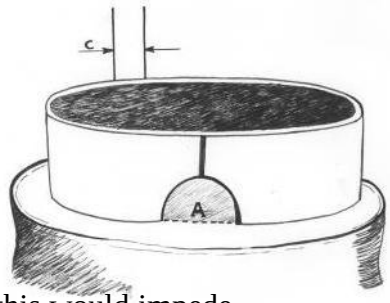
- The air entering the stove should exit the stove although changing its form (i.e. it leaves the stove as a different chemical compound)
- Additionally, there are combustible gases coming out of the firewood

These two facts call for the exhaust area to be greater than that of the air inlet. As recommended in literature we can make it 30% larger than the air inlet, in this case. Therefore, it becomes, *B*:

$B = 1.3 * a = 1.3 * 20 cm^2 = 26 cm^2$

### 3.20.4. Chimney

If chimney is required for the stove, then its area should obviously match that of the exhaust area. And since chimneys are usually cylindrical in shape, the diameter of their circular cross section can easily be calculated employing the formula of area of a circle. Thus, calling the diameter *C*, from $area = B = \frac{\pi C^2}{4}$,




$$C = 2\sqrt{\frac{B}{\pi}}, \quad \pi = 3.141$$

Doing the math gives,

$C = 5.75 cm^2$.

During operation, the chimney gets clogged with soot after some time and this would impede the exhaust flow. Therefore, the diameter can be increased up to 10 cm.

Regarding the height of the chimney, it should not be higher than half a meter especially for small kitchens. But, to eliminate smoke completely from the kitchen it can be made to rise up to another half a meter beyond the roofing of the kitchen. This means that the total length could go as high as 2 to 3 meters. If chimney is not to be used, a pot should be rested on the pot rests provided on the exhaust outlet. This is to regulate the smoke as a baffle as well as to utilize the heat of the flue gases before they leave the stove.

## 3.21. Mirt Stove

Mirt Injera baking stove was first developed by the Ethiopian Rural Energy Development and Promotion Centre in early 90's, when the stove was introduced for the first time to the Addis Ababa Market. Compared to the traditional open fire, the stove is proved to save fuel by 50%. All the fuels that we use on three-stone open fire (firewood, animal dung, branches, leaves, wood chip ...etc.) could also be used on mirt stove.

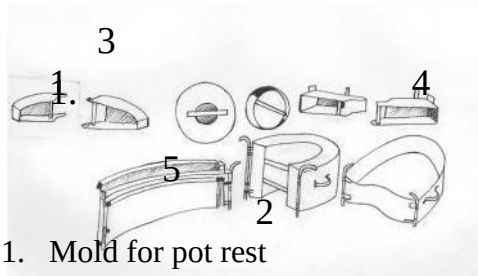
1. Chimney & pot
2. Smoke outlet 3.Mitad rest 4. Air & fuel

1Smoke outlet height: 7cm

2. Pot rest height: 14cm
3. Pot rest hole diameter: 18cm
4. Wall thickness: 6 cm

### 3.21.1. Production mold

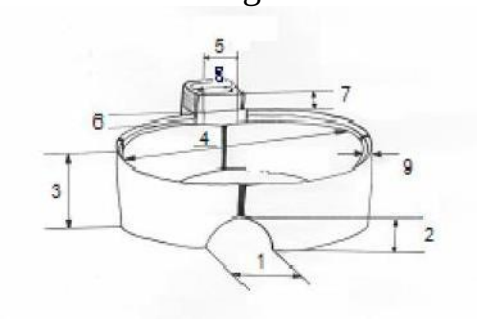
A set of mold consisting 8 different parts is used to produce mirt stove. The mold is to be manufactured from steel sheet metal of 1.5 mm thickness. Depending on its manufacturing quality and usage the mold can serve for not less than 3 years. Current market price of the mould is estimated ETB 600-900.




1. Mold for pot rest
2. Mold for wall
3. Mold for fuel inlet
4. Mold for smoke outlet
5. Mold for pot rest support structure

### 3.21.2. Main component parts of Mirt stove

Mirt stove is made of 6 different parts. Like any other improved stoves, it is important to maintain the dimensions of the stove, in addition to maintaining the raw materials and production procedures, to obtain the expected efficiency and hence fuel saving.

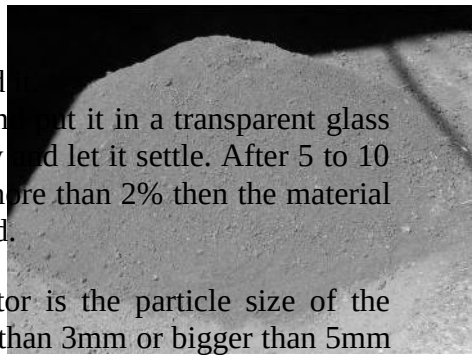



1. Fuel inlet base width: 24 cm
2. Fuel inlet central height: 11 cm
3. Wall height (outer): 24cm
4. Wall diameter: 62 cm
5. Smoke outlet width: 19 cm

## 3.22. Raw materials for mirt stove production

Mirt is produced from cement and river sand. If red ash (scoria) is available, it is preferred to river sand. For best quality stove, the sand or the scoria should be free from dust or any other foreign material. Otherwise, we may risk the strength and the efficiency of the stove. The biggest particle size of either of the sand or the scoria should not be greater than 5mm.

Regarding river sand, it is seldom available free of dust. There could also be lustrous particulate materials called silica which affect the strength and heat transfer characteristics. Thus, material selection is an important element of production to guarantee a good quality stove.



To select a good quality river sand

1. Observe a sample. If there is too much silica in it then avoid it.
2. To see the proportion of dust in the sand, take a portion and put it in a transparent glass bottle. Pour some water and shake well to mix it uniformly and let it settle. After 5 to 10 minutes time, observe. If the amount of pure loam is not more than 2% then the material could be used with some washing. If not then avoid the sand.

To investigate the quality of scoria, the most important factor is the particle size of the material. Material consisting of particulate sizes either smaller than 3mm or bigger than 5mm should be avoided since both affect the physical strength and the heat characteristics of the stove.

Non-fresh cement or that which is exposed to air and/or moisture is a good recipe for a bad quality stove. Care has thus to be taken to avoid such material to produce the stove as it greatly affects the strength of the stove, especially at its higher operating temperatures.

## 3.23. Preparation of production place

### a. Shade

Shade is needed as a workshop, to produce and store the stove. The size may depend on the production capacity needed but should not be less than $24m^2$ (6mX4m) in any case. For good ventilation, the minimum height should be 2.5m.

The floor should be made plane, whether made out of earth or concrete, to put fresh cast (which is wet and very fragile) without breakage or failure.

### b. Space for screening sand

River sand is to be sieved with 3mm mesh-size sieve. Scoria shall be sifted first with 3mm mesh-size sieve and then the remaining, which is retained on the 3mm mesh-size sieve, shall be screened on 5mm mesh-size sieve.

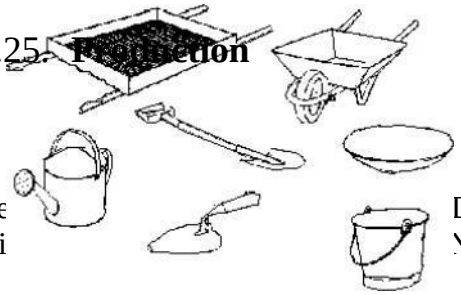
The sifted sand must be kept out of soil or any other dirt. For this purpose, a material, such as plastic canvas or any piece of cloth could be used. If not a special place should be prepared where the floor is lined with a thin layer of concrete. As much as possible similar care needs to be taken for the un sifted sand.

### c. Storage

If accumulation of produce is deemed unavoidable, a special place should be prepared. Care has to be taken in order that the produces are not eroded by water especially during the rainy seasons.

## 3.24. Tools and raw materials for stove production

### a. Tools

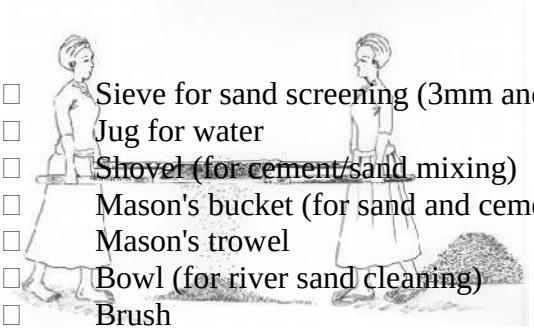


## 3.25. Production

### 3.25.1. Raw material preparation

## a. River sand

- Like already said, raw sand is first screened using 3mm mesh-size sieve



- Sieve for sand screening (3mm and 5mm mesh sizes)
- Jug for water
- Shovel (for cement/sand mixing)
- Mason's bucket (for sand and cement measurement)
- Mason's trowel
- Bowl (for river sand cleaning)
- Brush
- Stomping stick (wood or metal)
- Wooden board ( or Chip wood board )
- Gloves
- Set of mold

## b. Raw materials

- cement (fresh)
- river sand or red ash(scoria)
- clean water (but not necessarily potable)
- used car engine oil (for lubrication of mold and for easy ejection of cast from mold)

- The screened sand then shall be mixed dry with cement, with a sand to cement ratio of 3:1. The mixing is such that it should be homogenous.

- The homogenously mixed material is again mixed with water. Water is poured in to the mixture little by little and in steps while doing the mixing. It is difficult to measure the amount of needed water in advance but it can easily be known from the texture of the mix by looking at a handful of sample. In any case, the water should not be too much that the mix is very wet. This otherwise could lead to non-uniform cement distribution, more material consumption during production and heavy stove which all eventually lead to bad heat characteristics of the stove.

  Another disadvantage of excess water is that it makes production difficult, especially to eject the cast from its mold.

## b. Red ash (Scoria)

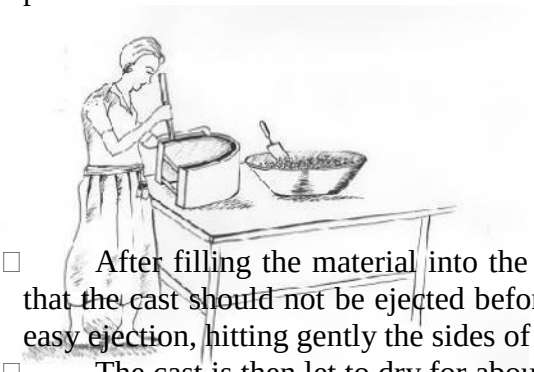
- Raw scoria is first to be screened with 3mm mesh-size sieve. The retained material on

the sieve then is put on 5mm mesh-size sieve for another screening. Note the step that the screening should start from the smaller mesh-size sieve. Then a homogeneous mixture is to be formed, by mixing, from both particle sizes of material in 3mm to 5mm ratio of 3:1.

- The mixture is again mixed with cement in 4:1 ratio before it is mixed with water. The water is mixed just in a similar fashion as in the case of river sand; little by little while mixing and checking the amount.

### 3.25.2. Production

- The producer shall first check that he/she wears his/her gloves and that all the necessary tools for production are available nearby.
- It shall be made sure also that the mold is clean and free from any debris that hinder production and extraction of cast stove part. If possible, one can make use of used car engine oil before starting production by applying it in thin film on the interior of the mold. Be wary of the oil against contact with skin, however.
- Putting the mold on the appropriate wooden board, mixed material is then to be poured into the mold. While doing so it should not be forgotten to pound the material with a piece of blunt-ended wood or iron bar with a moderate force.
- It should not also to be forgotten that, when producing the wall part of the stove, the appropriate mold parts that create the openings for fuel inlet or smoke outlet are put.



- After filling the material into the mold, then the cast is ejected from the mold. Note that the cast should not be ejected before putting it on its place where it is to be dried. For easy ejection, hitting gently the sides of the mold with a piece of stick might help.
- The cast is then let to dry for about 24hrs before it is put off from the wooden board it has been standing on.
- After dismounting, the produce is then ready for watering. Once produced a stove part must be watered twice a day, at least for 7 days before putting it for sale or into service.
- After each day of production, cleaning the molds and all the working tools is imperative. Applying a thin film of engine oil, especially, to the interior of the mold helps protect it against damage by the cement.

## Notes:

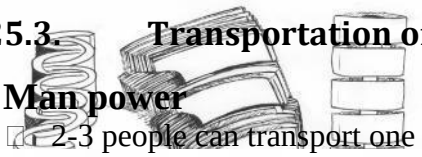
The following pieces of advice are good for quality product, safety against personal injury and for prevention of damages to the working materials:

- Producers are advised always to lower bending their legs, rather than bending from their waste, to pick up or lower heavy things, such as stove parts.
- Tools, such as shovels and mason's trowel should be put in such a way that

  they are not to recoil when for example accidentally stepped on them.
- Whenever watering the produces we should not do that while the produces are on the wooden boards in order to avoid damage to the boards.
- Produces of different days are advised to be sorted during watering and storing.

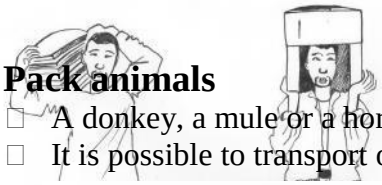
- Orderly storage of parts makes easy sorting and hence First-In-First-Out of them and makes the management of the store, efficient.

### 3.25.3. Transportation of mirt stove



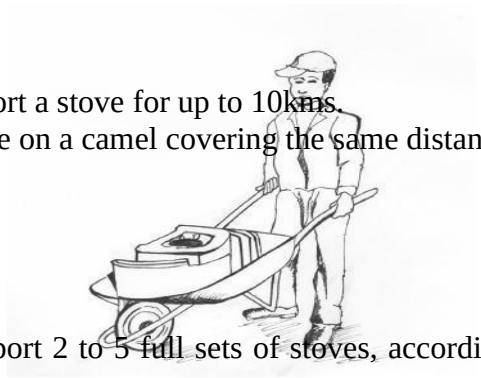
**a. Man power**

- 2-3 people can transport one full set of stove for 1.5 to 2kms.



**c. Pack animals**

- A donkey, a mule or a horse can transport a stove for up to 10kms.
- It is possible to transport one more stove on a camel covering the same distance.



**d. Animal powered wagons**

- For up to 25kms it is possible to transport 2 to 5 full sets of stoves, according to the accommodation capacity of the wagon.

**b. Wheel barrows**

- It is possible to transport one full set of stove for up to 6kms.

**e. Vehicles**

- On gravel roads, according to the specific situation of the roads, we can transport stoves for 50-100kms. The number of stoves being transported may vary according to the carrying capacity and space of the specific vehicle.
- However, for asphalted roads it is possible to transport more than 100kms of distance.
- If stoves are to be loaded on the roof-racks of vehicles, care must be taken to avoid damage by rubbing against each other. Thus, used carton paper, straw or any other thing serving the purpose, could be put between the parts and everything must be tied tight with rope. It is also possible and helpful at the same time, to put light loads (e.g. sacks of grains, etc.) on top of the stove parts.

## *3.26. Installation of Mirt stove*

It is recommended to install mirt, and any other stove for that matter, on an elevated platform. Therefore, preparation of such unit in the kitchen precedes the installation of the stove. The following are among the advantages of the platform:

- Tiredness and inconvenience during Injera baking are greatly minimized
- It is easy to control the fire in the stove
- It is possible to put around and to use required materials for the baking easily and conveniently
- Children and animals, which dwell usually in and around the kitchen, may be less risked of any fire danger
- Wetting from spill over of water and other liquids inside and around the stove is less likely to happen.

### 3.26.1. Different Types of Platforms

#### a. *Wett* (Solid) Platform

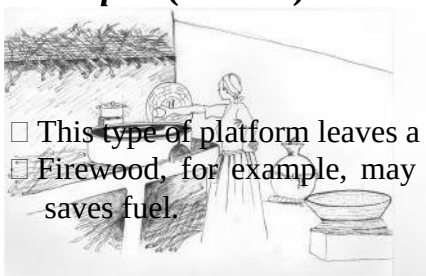
#### *Wett* Platfrom from Earth and Stone

- Bigger stones are first put along the apparent rim of the platform.
- The interior then is filled with gravel and earth to the desired level.
- The top of the platform shall be compacted and (water) leveled well, wetting it with water. All the exposed faces could also be lined with mud to keep the aesthetics.

#### *Wett* Platform from Stone/Hollow Block/Brick

- Like in the above case, the would-be rim of the platform is set first by putting either stones, or blocks or bricks, all around, to the desired level of the platform.
- Again, the interior is to be filled with gravel and earth.
- The top most part is then to be filled with a layer of concrete, by first putting small pieces of stones and gravel beneath. The concrete is to be made out of cement, sand and gravel, in the respective ratio of 1:2:3. The alternative to the concrete is brick or hollow block. Do not forget to water level them all, however.

#### b. *Seqela* (Hollow) Platform



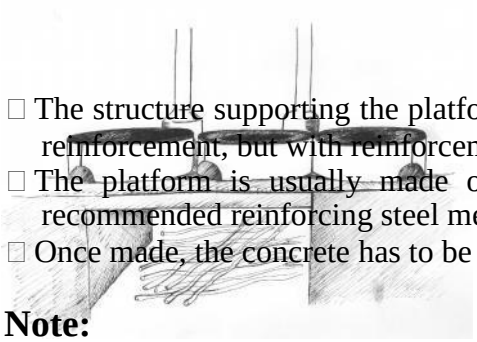
- This type of platform leaves a space underneath; the space can be used for storage.
- Firewood, for example, may be stored in the space. This is important as dry fuel itself saves fuel.

### 3.26.2. *Seqela* Platform Made from Earth and Stone

- Wooden poles, preferably of branches of 'Y'-shape, are first erected in distances of 50 to 80 cm, depending on the desired area of the platform.

- A mesh made of wood is then constructed, put, and joined by any means, with the top of the erected wooden poles.
- A layer of gravel is applied on the mesh before applying a layer of soil finally and is finished.

### 3.26.3. *Seqela* Platform Made from Stone/Hollow Block or Bricks



- The structure supporting the platform can be constructed from stone, or bricks without any reinforcement, but with reinforcement in the case of hollow blocks or concrete.
- The platform is usually made of concrete with steel or wooden reinforcement. The recommended reinforcing steel mesh size is 10 to 15cm$^2$ using 10 to 12mm thick bars.
- Once made, the concrete has to be watered for 7 to 10 days.

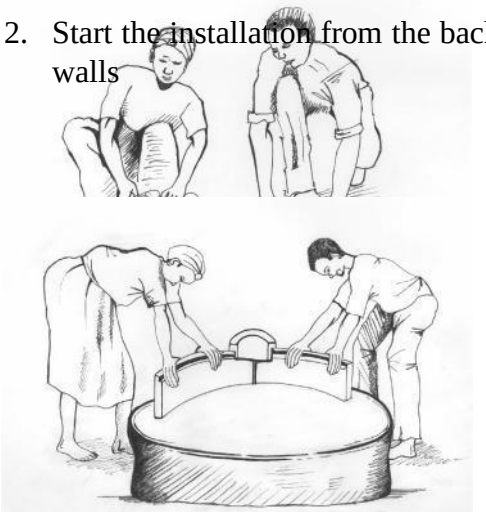
**Note:**

The fire bed in mirt stove is strongly advised to be made of clay material such as used/broken Injera baking pan, *Mitad*.

## *3.27. Installation of Mirt Stove*

1. First mud mixed with straw is to be prepared as a bonding material for the parts

2. Start the installation from the back of the stove, i.e., from the 'U' and follow with the rear walls

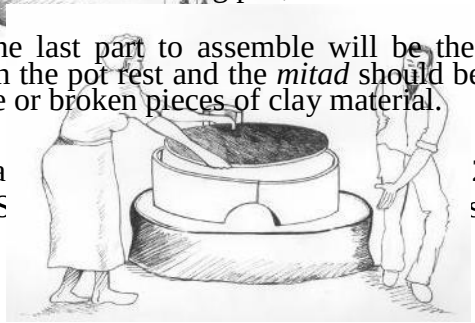


3. Then assemble the rest of the walls as shown in the figure

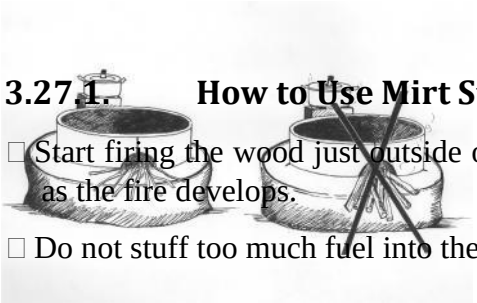
4. Finally all the joints shall be filled, lined and finished with mud.

4. Continue with the baking pan, the *mitad*

5. Then the last part to assemble will be the pot rest. The opening that may be created between the pot rest and the *mitad* should be stuffed with mud together with small pieces of stone or broken pieces of clay material.



### 3.27.1. How to Use Mirt Stove



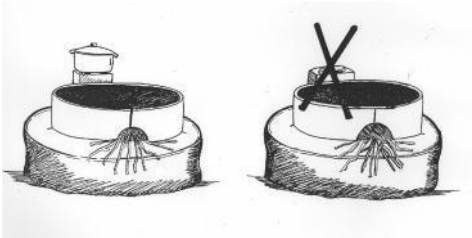
- Start firing the wood just outside of the stove at its door in order to develop it and push in as the fire develops.
- Do not stuff too much fuel into the stove. It suffices to put just a little amount turn by turn.

- Use dry wood.
- Always put something on the pot rest, if not a pot of something to cook or

GTZ-Sustainable Utilization of Natural Resources for Improved Food Security: Energy

boil. This not only allows the efficient utilization of the fuel but also regulates the speed of the smoke exiting the stove thereby optimizing the heat distribution in the stove.

- It is advised not to puff into the stove to restart the fire. Use a flap like thing (e.g. a piece of hard paper) to blow in air. Otherwise, the flame may bounce back and harm the face.



- Water or any similar liquid is bad for the stove during or after operation. Contact against such things must therefore be avoided.
- After each session of operation, ash has to be removed from the stove. This is important for the proper combustion and hence fuel saving of the stove.
- It is desirable to repair the stove joints whenever necessary. The only openings on the stove should be the fuel/air inlet and the smoke outlet.
- It is possible and necessary to substitute any failed part of the stove.
- Whenever necessary the user may seek assistance from a stove producer or the concerned technical staff from the nearby energy or agriculture offices.

# 4. Specific area of the study called Wag Himra zone Ziqualla Woreda

Since the area is more susceptible and researcher selected based on his experience worked their and reviewed it. Wag Himra zone is found between $12^0$ $15^1$ and $13^0$ $16^1$ north latitude and $38^0$ $20^1$ to $39^0$ $17^1$ east longitude. The zone shares borders with Tigray National Regional state (to the north and east), North Wello zone (to the south), North Gonder zone (to the west), and south Goder zone (to the west). Wag Himra a special administration zone of the Agew ethnic group with the Amhara National Regional state. Before the establishment of Wag Himera as a special zone in 1987, the people of Agew ethnicity in this area were within

Wello, North Wello, Tigray and Gonder administrative units. Sekota is one of the two woreda selected from Wag Himra zone for this pilot study on vulnerability.

Wag Himra comprises three major ecological zone: highlands (dega), midlands (weina dega), and lowlands (kola), which constitute 4.6, 29.2 and 66.2 percent of the total area of the zone respectively. The most common features of the zone are its rugged topography characterized by mountains, steep escarpments and deeply incised valleys. There are more than 40 permanent and seasonal streams-including river Tekeze, a major tributary of the Nile. Thes river, leaves and streams carry enormous amount of soil from the highlands to Tekeze river, leaving the organic sol layer in areas of the zone very thin, often less than 10 cm deep. There is no detailed study of the irrigation potential of the rivers and streams. The very ragged topography coupled with the flow of streams in deeply incised valley hinders the use of streams for irrigation. An estimate by Wag Himra planning and Economic Development (WHPEDD 1992) suggests that in Sekota Woreda about 687 hectares of land is irrigable. Currently, percent of this (296hectars) is under irrigation and NGOs also participated water supply from the ground.

Ziqualla it is located between $12^0$ $28^1$ and $13^0$ $16^1$ north latitudes, and $38^0$ $20^1$ and $38^0$ $59^1$ east longitudes. It extends for about 86 kilometres in the north-south direction and about 70 kilometres in the east-west direction and it has compact shape, and has area of 3020km2.

Ziqualla is found in the western part of Wag Himra Administration zone, and shares borders with Sekota Woreda (in the east), Dehana Woreda (in the south), Belessa Woreda (in the southwest), Janamora Woreda (in the west), and Beyeda Woreda (in the northwest).

Based on the traditional climatic classification, Ziqualla is divided in to two agro-climatic zones: Kolla and weina-dega, with most parts of the woreda (about 89%) falling in Kolla AEZ. As is characteristics of kolla areas in central and northern parts of Ethiopia, drought is a major hazard in Ziqualla because f the high variability of rainfall compared to its low average as well as because of the size of population affected by low levels of rainfall in any one year.

The erratic seasonal rainfall, coupled with the steep slopes and the bare plains with little pr no plant cover have led to low retention of ground water and high run-off, with in turn led to extensive soil erosion in the woreda.

According to Amhara regional state, (2002) human epidemics constitute a major hazard in Ziqualla because of the low level of environmental or individual hygiene and preventive public health services. The disease experienced by the highest proportion of households in the sample is malaria (77.8%), followed by typhoid fever (62.6%), diarrhoea (47.5%), and measles (22.2%).

Family size and the number of farming households are rising. There is over-utilization of land, environmental stress (deforestation and erosion), and migration in search of livelihoods in other areas. Availability and utilization of family planning services is very low.

Dependency ratio is 103 percent. And data from the household survey indicate that the proportion of households in which members' out-migrations with higher numbers.

## 4.1. Environmental Degradation

The rate of soil in the woreda varies from a less than 0.50 mm soil-depth per year in the north to a loss of 85 mm soil-depth per year in the southwest. More than 65 percent of sample household acknowledge the percent of sample household acknowledged the presence of some level of erosion.

Firewood is the most important source of energy for cooking followed by dung (the later is used by 71 percent of households). The depletion of firewood has currently led to the extraction of roots of former vegetation cover. Ziqualla has been stripped of vegetation, and shortage of grazing and increasing fuel wood scarcity are concerns related to vulnerability to food insecurity in the woreda. Moreover, reforestation is very minimal.

Shortage of grazing is the most widespread problem as reported by 80 percent of the households in the study. All grazing areas belong to the peasant association, thus all households are using communal grazing grounds. The area considered as communal is in most cases wasteland, unprotected and highly affected by degradation. These overgrazed communal areas would make no significant contribution to livestock resources. Consequently, households earn little or income from livestock and livestock products. In year of severe drought, movement of livestock to neighbouring woreda in North Gonder in search of pasture is common in parts of the woreda.

### *4.2. Demographic Characteristics*

The results of the 1994 population and housing census show that population of Ziqualla were 48,860. About 99 percent of the population lives in rural areas. Crude population density was about 16 persons per/km2 in 1994 and increased to 18 persons per/km$^2$ in 1999. Total fertility rate is estimated to be 6.9.

The proportion of the population engaged in production activities is low not only due to high dependency ratios, but also due to low rate of labour force participation. Only 48 percent of the household members aged 10 years and above are economically active.

Illiteracy was 90 percent in Ziqualla woreda (94.6 for females and 87.5 for males). Only 10 percent of the household members aged eight years and above are reported literate.

The level of education in Ziqualla is very low: the 1994 census found that gross enrolment ratio in Ziqualla was 2.7 percent; 0.4 percent for females and 5.1 percent for males. Enrolment ratio of children between 7 and 14 years of age was 33.4 percent in 1991. Dropout rates in 1992 were low in all kebeles, but the levels in Kolla Kebeles is alarmingly high-81.7 percent of all students and 90.4 percent of girls drop out of school before they reach grade 4.

The infant mortality rate for Ziqualla is found to be 161, while child mortality is estimated to be 95 per 1000 live births. And life expectancy is estimated to 43 years for females and 44 years for males.

## *4.3 Environmental aspects of Ziqualla Woreda*

Excessive erosion and result poor quality soil have led to declining fertility and declining crop yields, which in turn contributes to food insecurity. Fallowing has been abandoned and marginal lands were already colonized. In the due course accelerated deforestation and loss of other forms of vegetation has taken place. As the result increasing pasture and fuel wood scarcity become a related concern, which aggravate food insecurity. Conversely, reforestation and other conservation practices are minimal. According to federal democratic republic of Ethiopia Amhara National regional State commission for disaster prevention and preparedness prepared a plan the promotion of an integrated watershed management is a major concern to rehabilitate natural environment of the Woreda, Awerness creation for the adjustment of livestock number according to the carrying capacity of the grazing land and improvement in pasture management and use is another possible area of intervention. Promoting resettlements of people from the excessively degraded areas to the better fertile areas in the region.

Infrastructure particularly all the rural people of Ziqualla woreda are living in highly isolated localities. The situation is much worse for those who live across the Tekezze river for they are surrounded by the river in the east and the steep escarpment of the semen mountain in the west. They were remaining isolated for nearly half of the year due to lack of a bridge to cross the river due to the contribution of donors the bridge already built.

Therefore, market access partly through increased infrastructure, particularly construction of intermediate roads could have strong positive impact to enhancing the livelihood of this area. The construction of rural roads is very much critical in ensuring access to this people than any other places.

## *4.4 Empirical evidence of the study*

Air pollution further affects not only nature but the family as well. The pollution affects our mothers' health. Those mothers in the above-stated areas of the country are directly exposed to smoke which is being *Emitted* to the households. Then, the fumes emitted into the surrounding air attack our mothers' and other family members' respiratory system at household level. Therefore, such issues can be a case in point in my family.

In our household, my mother usually utilizes cow dung and firewood as a source of power to prepare foodstuffs and other items. The fumes have been affecting my mother's health. Owing to this unnoticed effect of the emission, my beloved mother got infected with womb cancer which highly contributed to the loss of her life. She engaged in serving her children, other youth and adult people in the house to feed equally, for destitute and even relatives and the village community members by baking *injera* (meaning the Ethiopian bread).

Until recently most of Addis Ababa city Communities particularly those poor people live outskirts of the city. They use traditional cooking i.e. fire wood & animal dung as a source of fuel Energy rather than electric power as source of energy for both baking *Injera* and sauce which is stew in a closed dish. Most of "Chefe Sefer"(small village) which is located around French legation use animal dung as a source of fuel energy. The facts that are using animal dung traditionally by shaping it into the ground with their bare hands seriously affect their health condition as it smells bad. To use it as a fuel which is traditionally called "Kubet", the animal dung is dried and used, which in turn changes into smoke and ash. Ash, which is the final product of burning "Kubet" is not used as an organic fertilizer. But these people who use this fuel frequently are almost always susceptible to pollution.

Consequently, I designed a Mini Project on Enriching and improving the quality or value of making better things for the future thereby reducing air pollution at different levels. My intention is to embark on the Project which, in turn, results in saving every mother and the respective family's life from getting affected by carbon emission from the household in rural areas of Ethiopia. I will start the Project soon after I have completed the write-up of my MA thesis.

In addition, the demands of electric power in rural and the outskirts of the cities and towns in Ethiopia have endangered children's and youth's health conditions because they use lighting from kerosene lamps at night time. The students at different levels of the education system in those areas of the country do not comfortably study their lessons at night after they diagnosed during spite out their saliva blended with soot. So, we can reduce this problem by organizing and conducting the above-mentioned Training and, to some extent, by utilizing modern fuel saving device. Therefore, the combined effects of the Approach will save wood consumption per hectare and then improves the clarity of the air.

In the same framework, solar energy is the other major alternative to reduce air pollution. Such energy from the sun can be the most modern smokeless energy release which, in turn; helps for cooking and providing light everywhere the rays are available. Although there is a shortage of finance to implement my envisaged Project, we can reduce a significant amount of fuel consumption per day (which is millions of gallons or barrels) - substituting their customary ways of using fuel with modern energy saving technologies at different levels.

In order to put in place those appropriate household improved technologies for both rural and urban areas, the curriculum in the Ethiopian Educational System should be re-visited and made tailored to solve the aforementioned multi-dimensional problem. To this end, those concerned Departments at TVET Colleges (including draftsmen, electrical engineers, physicists, mathematicians, etc.) can make modern cooking devices and mechanisms for utilizing solar energy. By so doing, we can increase the beneficiaries of such technologies.

Thus, a concerned government body may open TVET College where demand arises in every rural and urban area for this purpose and for income generating activities (IGAs). Those entrepreneurs, on the other hand, that have established small and micro enterprises can work on such business endeavours to solve the current problem and to get benefit from such innovation. In the end, we can make difference in most of the fuel saving stoves which are made by the Construction Department in the TVET.

The small Project also includes the drawbacks of the cities and towns in Ethiopia. Since the cities are overcrowded dirty and noisy sometimes un peaceful; prostitution, destitute, run-down, trapped, live without clean water, unplanned, traffic jams, aeroplanes, cars, buses, trucks, factories and source pollute the air with fumes currently HIV (AIDS) that endanger peoples health. These drawbacks include solid and liquid wastes, human and animal wastes and animal dung which have contributed to air pollution for the purpose of recycling and reusing it.

## 5. Conclusion

So, if you have something about my shared ideas, please lend me your views in your 'utopian universe'. We can do something by sharing our ideas with each other thereby reducing air pollution better than before. In summary, we can reduce the amount of carbon emission into the air by supplying modern cooking device (i.e. *mitad*), solar device and Small Scale Bio-Gas Production for every rural and urban area. Therefore, we can increase our technological beneficiaries, transforming traditional ways into modern ways of living. Due to this fact, since the world is dynamic we shall improve our curriculum at the TVET Colleges in the country to be responsive to the societal and economical problems. The quality of life in the woreda is low as indicated lack of using technological equipment and the increasing crude population density.

## 6. Recommendation

Implement effective and efficient policy interventions encourage invention and innovation for rural areas support and strive for proper utilization of affordable appropriate technological equipment for the farmers.

Awareness creation to minimize cultural challenges that undervalue girls' educational attainment,

Provision of informal education for adults to increase awareness for farm management and natural resource protection are other areas of intervention.

Provision of health services and educational in family planning and primary health care,

Capacity building-in both personnel and equipment are commendable,

In the due course accelerated deforestation and loss of other forms of vegetation has taken place. As the result increasing pasture and fuel wood scarcity became a related concern, which aggravate food insecurity. Conversely, reforestation and other conservation practices are minimal. Hence:

The promotion of an integrated watershed management is a major concern to rehabilitate the natural environment of the woreda;

Introduction of alternative energy sources;

Awareness creation for the adjustment of livestock number according to the carrying capacity of the grazing land and improvement in pasture management and use

Promotion resettlements of people form the excessively degraded areas to the better fertile areas in the region; are other possible areas of intervention.

# Thank you very much!!

## 7. In 1998 E.C or in 2005 G.C, Save the Children United Kingdom (SC UK) attested me by writing the following letter of accreditation:

### *7.1. To Whom It May Concern*

This is to certify that Ato Berhanu Tadesse Taye has delivered a ten-day energy efficient stoves production /EES/ training for trainer TOT training organized by SC-UK. He has performed a very good knowledge transfer both theoretical and practical aspects for woman who have intended to establish an IGA in Sekota Woreda. During the training and post production of the EES he has been very concerned and cooperative.
We wish him all the best.

With regards,

including unread signature

Haile Mulualem
Project Manager

Save the Children

UK

## To whom it may concern

This is to certify that Ato **Birhanu Tadesse Taye** has delivered a ten-day energy efficient stoves production/EES/ TOT training organized by SC-UK. He has performed a very good knowledge transfer both theoretical and practical aspects for women who have intended to establish an IGA in Sekota woreda.

During the training and post production of the EES he has been very concerned & cooperative.

We wish him all the best.

With regards,

Haile Mulualem

Project Manager

### 7.1.1. Little to clarify the above

About modern fuel saving pot “mitad” at that time our beneficiaries who were more than 300 female farmers obtained the production energy efficient stoves training. During the training delivery almost 99% of the trainees attuned the training successfully. Despite the usual working habit they had before, for example, attending churches for they have had religious convictions, they strictly attended the training as I seriously took attendances due to the case if someone misses the classes; no longer understand the production stapes of the devise. The attendance was so strict; if they missed one session they would be penalized their per diem of SC UK. The aim of the training was empowering woman in terms of income problems, modern way of doing household activities; reducing air pollution...

The production appliance shape also Circle Mold caste which produce block product by using cements and refined sand by taking into consideration proper ratio. Hence, one can produce fuel efficient stove “*Lakech Mitade*”. Even after complete their training the donor purchased and provided for each farmers production machineries i.e. mould cast production device and provided start-up money for the purpose of sustaining their business. We can easily understand how woman farmers were healthier and we can also calculate the reduction of air pollution by using single family consumption of Bread "*Injera"*. According to population and Housing Census of Ethiopia in 1999, family members having 6.9 per heads, (total fertility rate is estimated to be 6.9) since each family consists of 6 members, they destroy 0.000398 per hectare after baking single “*Injera*” as they use fire wood traditionally. But after training they started using energy efficient stove device, they reduced using the fire wood 0.00023 per hectares of land when we calculate the consumption of the entire families who started using the energy efficient device), little amount of wood per hectare of land has been saved. When we calculate entire family (300 heads) consumption per day, per month and per year we can get significant amount of wood per hectare of land has been saved. Both the above number standards set by the researcher due to make the scientific square root calculation used by the researcher were make simplicity for their level of understanding.

As I first witnessed the natural beauty, the kindness of the people, and the small huts in the rural life after crossing 60 km on foot, I was filled with awe. Past from Ziquala town, farmers of the village greeted me with a warm welcome and a full course traditional cuisine, serve me by using “Mesob” as a tray this show their generosity and open-handedness. Despite their impressive kindness and the original nature of the environs, the deserted landscape which is at risks of severe drought in case of rain shortage put me in agony.

The kerosene torch struggling to kindle through the darkness during the night was kind of funny to me as I just came from city, till I realized it gave me a smoked spit in the morning. I spent the night worrying about what might happen to these people if the rain fails to meet the regular cycle since the area drought affected area. However, the good nature and sympathy of the people with the blinking torchlight was entertaining, the susceptibility of the area to drought is so disturbing which drives away my sleep till midnight and further than. Crossing

long distance on foot due to this problem my body was completely exhausted. In contrary, the farmers' show no sign of fear as they devotedly believe in God, which later strengthen my spirit and relinquish repeated stress to rest myself. The situation I saw there has left me with homework to do better things for them.

**UNESCO-UNEVOC**

Dear Berhanu Tadesse,

Many thanks for your interesting message. We would like to invite you to share your views on the UNEVOC e-Forum. This is an online mailing list of more than 2,300 TVET experts that discuss the challenges of TVET and among other things, sustainable development. Perhaps you would be interested in sharing your ideas on solar-cooking with the other members? You can sign up for the e-Forum by filling out the form attached in this email. http://www.unevoc.unesco.org/subscribe.php. If you have any questions, please email us at info@unevoc.unesco.org.

With kind regards,

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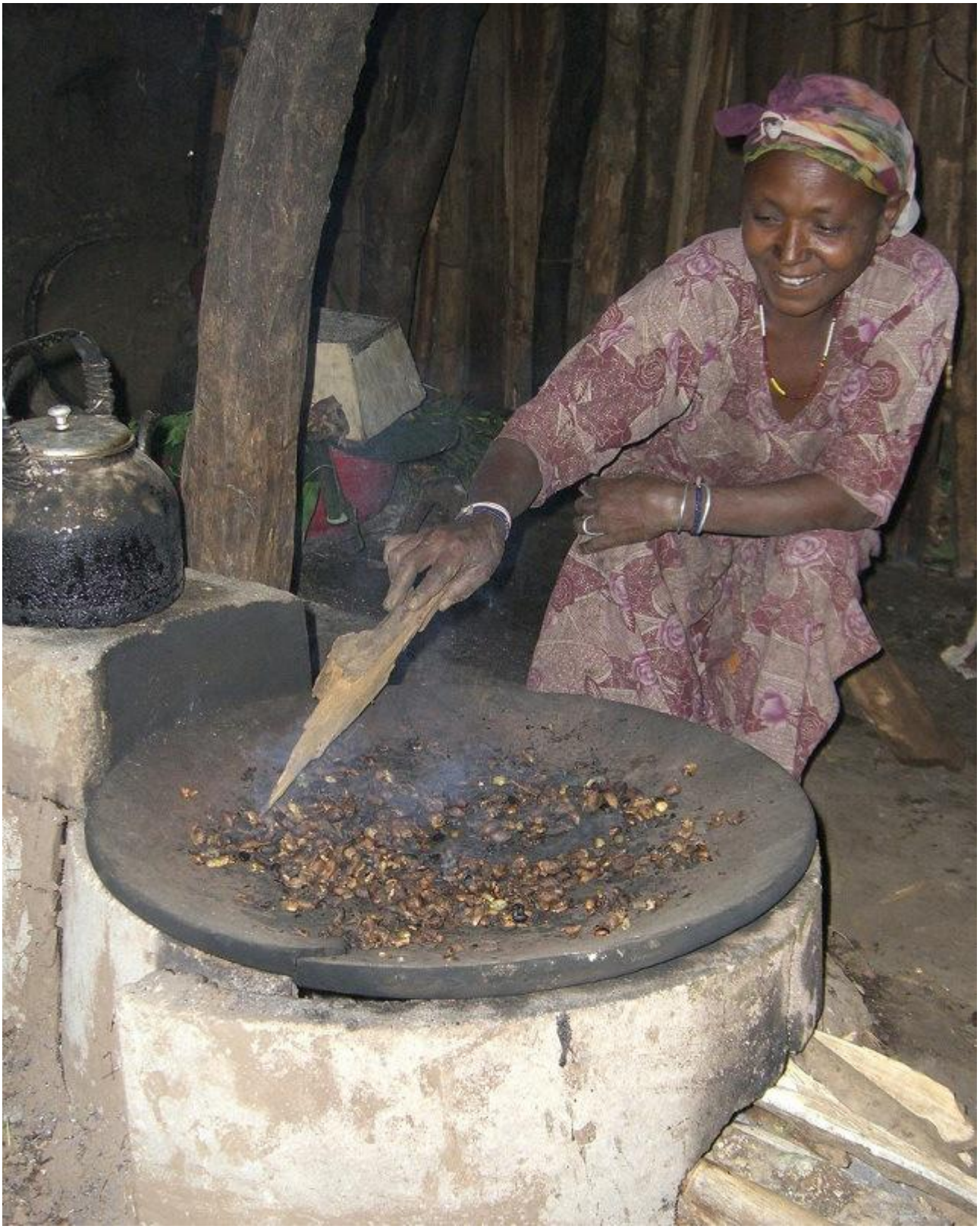
Old (traditional) and modern way of cooking and baking Injera.






- ✓ **Readers Comment on the article**

Samuel Tamene This is a brilliant idea forwarded by one of the bright intellectual who got a firsthand exposure in his expertise. We value his commendable contribution in shaping a safe future of our fair nation Ethiopia whose prosperity meant everything for us. July 22 at 8:37am

**Berhanu Tadesse** About modern fuel saving pon "mitad" at that time our beneficiaries who were more than 300 female farmers obtained the production energy efficient stoves training. During the training delivery almost 99% of the trainees attuned the training successfully. Despite the usual working habit they had before, for example, attending churches for they have had religious convictions, they strictly attended the training as I seriously took attendances due to the case if someone misses the classes; no longer understand the production stapes of the devise. The attendance was so strict; if they missed one session they would be penalized their per diem of SC UK.

The aim of the training was empowering woman in terms of income problems, modern way of doing household activities; reducing air pollution... The production appliance shape also Circle Mold caste which produce block product by using cements and refined sand by taking into consideration proper ratio. Hence, one can produce fuel efficient stove "Lakech Mitade". Even after complete their training the donor purchased and provided for each farmers production machineries i.e. mould cast production device and provided start-up money for the purpose of sustaining their business. We can easily understand how woman farmers were healthier and we can also calculate the reduction of air pollution by using single family consumption of Bread "Injera".

According to population and Housing Census of Ethiopia in 1999, family members having 6.9 per heads, (total fertility rate is estimated to be 6.9) since each family consists of 6 members, they destroy 0.000398 per hectare after baking single "Injera" as they use fire wood traditionally. But after training they started using energy efficient stove device, they reduced using the fire wood 0.00023 per hectares of land when we calculate the consumption of the entire families who started using the energy efficient device), little amount of wood per hectare of land has been saved. When we calculate entire family (300 heads) consumption per day, per month and per year we can get significant amount of wood per hectare of land has been saved. Both the above number standards set by the researcher due to make the scientific square root calculation used by the

researcher were make simplicity for their level of understanding. **July 22 at 8:48am**

Samuel Tamene Mitigating climate change in general and air pollution in particular demands efficient, effective and sustainable use of different alternatives like solar harvesting and clean energy solutions. So, your effort is a cutting edge approach in building a green economy July 22 at 8:58am

Berhanu Tadesse You are also a person who lives with ambitions (strong desire to achieve this theme) which means that strange desire to achieve green area of land concerned with protecting the environmental pollution. Let me tell you one great achievement. While sitting in his bath, the Greek scientist Archimedes suddenly shouted our "EUREKA" (I have found it) when he had a flash of inspiration which enable him to formulate his famous principle concerning the displacement of water, hence, we'll be both inventor and innovative.

Mesfin Haile your idea is really fantastic. But don't WORRY b/s after the completions of great Renaissance dam your threat will be destroyed. July 23 at 4:33am

Berhanu Tadesse Dear Mesfin, really thanks for your comment. But what I want to write is about invention and innovation paradigm and importance adduced.
Do you think the dam project alone fulfils our need of Energy (light power)?

Is the Dam project alone fulfilling our need of light power? What about government intention concerning the light power to sell for neighbouring country or distributing every corner of our country? Please Ato Mesfin make cost benefit analysis because for every corner of rural area the people live scattered, not organized manner, can the government address all citizen who live every corners of our country? What about entrepreneurs and enterprise work concerning producing and generating their own income? Or are you saying it is the only works of the government? Read the demands of innovation concerning light including that of more developed countries like USA more interesting to accolade both invention and innovation. I would like to give you example in USA I don't know the name of the inventor but he/she/they

create in animal farms how to use cyclical method animal production feeding and using their waste maters by changing it in to gas fired and also using fertilizer in addition to generating their own income. In India also making solar light at rural India as I have mentioned above really they did it which country is well developed India or Ethiopia in terms of technology and others?. I almost always appreciate both invention and innovation, you know very well rural town more than me because you came from there but I understand that you don't know rural area more than me because that you know my experience related to rural areas. Be prepared for all contingency plan be driving forces than restraining forces, be one of social problem solver, be critical thinker than resistant to change Since you are one of TVET executives believe that innovation is related to social problems and instrument for problem solving. Understand that research and development require rigorous and specific functions.

Thanks to inventers and innovators to accomplish professional missions, Know that knowledge is developed through discussion criticism and self-criticism

Acquire knowledge through scientific methods and understand that self deception is anti development. Don't forget use only as a slogan i.e. "expected programme outcomes of TVET provide and institutions strengthened to be centers for technology capabilities' accumulation and transfer". I would like to add neither one "there is nothing more difficult to carry out nor more doubtful of success, nor more dangerous to handle the initiate of a new order of this". (Machiavelli) July 24 at 4:08am ·

Samuel Tamene Dear Birhanu, I read your comments carefully with regard to using renewable clean energy solutions. U replied that innovation and entrepreneurship must be our driving forces to attain clean energy security. To reach this level we need a paradigm shift July 31 at 1:17am

Samuel Tamene Not only this, the government ought to encourage private sector active involvement in every direction if we want clean energy alternatives visible growth and sustainable achievement's a fish can't leave without water; this initiative should deploy local talentJuly 31 at 1:25am]\

Samuel Tamene Dear Mesfin, energy alone can't make any visible difference w/o human capital. I want to remember you that once Marx said that to have a production u need to have land, capital, utilities, and labour. Now in the 21st century, u must have intuitive idea. Face bookJuly 31 at 1:34am

Berhanu Tadesse Appraise on the Uses of our natural resource Indeed, his problem was stick only on one project. Indeed he can suggest but this is not the solution, we can do several projects at a time there is clearly no single, widely accepted version of best practice stick on government or private alone the strength of Mesefin is he know after the completion of the dam several farmers, village workers, towns and cities workers or entrepreneurs will be beneficiaries from this project in different ways. What I want to express is as a citizen I contributed initial project lintel notion provided one of top government officials his name is Professor *Andrias Esheta*. in 1998EC I was attended a meeting on climate change in *Bhardar* my work were at ministry of Agriculture as disaster prevention and preparedness act as department head during that time I perceived several things i.e. we can't use our natural resources properly or by avoiding poor systems of handling our resource. Hence in 1998EC I gave for him before he got sick 17 pages of paper on my observation of desert area of our country and evaluate, appraise and assessment on politician and policy makers about problem alleviation. Top officials problems in terms of making and using proper policy for their country and their society the paper also included source of finance for making that big dam, how to pull out the water from the lower place to higher place, and also all cities water supply problem alleviation including regional level. I brought from Addis Ababa but I saw the problem of rural and desert area of our country I felt thirst, feel everything really like them and more than them during my visit on my feet more than 60km to 250km and above starting from 5 days to one month and above for almost for 3 years work experience frequent time tour with related to Agriculture work on farmers, I'll published this paper after finishing my thesis. August 2 at 8:21am ·

Jantirar Guangul your initiation is so incredible and a great step to show your concerns to the generation to follow up your footsteps but how much does Ethiopia contributes carbon dioxide emission to the atmosphere??? What I know is Africa emission is just one percent, I would like to recommend to u that we Ethiopian should focus on deforestation rather than talking about co2 emission, keep it up bro August 2 at 10:00pm via mobile

Berhanu Tadesse Dear Jantirar Guangul Indeed, what I a sure is our contribution is insignificant amount pollute the air when comparing to that of developed nation but we should have to be enthusiastic and paradigm (model to other country) country combat even for little emission of air pollution because it'll affected mother health and soil erosion what I have mentioned it in the first parts. Let you clear your notion about the issues of deforestation and Co2. Really thanks allot about your constructive idea. August 3 at 10:55am via mobile ·

Timothy Issa Mtiti My friend Berhanu you are right, and I know that, but the problem the ones which polluted are the powerful countries, such as USA, China, South Africa...so we should do nothing until they sign those accords, is why I suggest to start with the practice which must reduce pollution for possible to reduce it out of any accord yet signed, for the actions is the imperative; when the accords are signed all we are going to benefit the money from them, and then do more than before, that is my advocacy, for children, women and adults (people) still to die, to suffer, to lose their heritages, family members, beloved ones, is so sad my friend, let me to weep and cry in my inner (pause)! Bye for the remembrance September·

Berhanu Tadesse Indeed, I appreciate the qualities and characteristics of my all friends which present your interesting message. Me also, I don't deny about African wealth. But the responsible bodies can't stop migration. I strongly agree with Thimothy ideas i.e. Africans should develop itself; we have potential live with comfortable and making wealth but not enough skills, expertise, invention, innovations, to reach the MDG. If the God give a chance peace, tranquility and respecting critical thinkers we will be the only continent lead and comfortable place for the entire human beings by using the only continent Africa than the remaining continent comfortable for human binges. If we are allow to live together. But we don't have love and affection with each other, due to hostility, selfishness, corruption, etc we can't help with each other and quarrel even the family members quarrel due to mother and father wealth hear in Africa, most of new comer want to inheritance owners wealth than making his own or her own asset, discriminating with each other and oppress their own family members. We should have to cry from the bottom of our heart to cure from this problem. The victims break our heart. Let us to weep and cry until to get God punishment. Respectfully yours my friends! September 9 at 6:02pm via mobile ·

Timothy Issa Mtiti Thanks, another wait the will of God in Jesus Christ, when He can desire to raise up Africa continent as a world power as in the last time with the Egypt! For with the will of our God in Jesus Christ all is possible, for

makes impossible to be possible! I believe in that; but even so, the partnership, globalization aspect is imperative my dearest friends and brothers! September 10 at 11:53am

Berhanu Tadesse I know Bruk is always strives to overcome the problems of unemployment and under employment. He works day and night; he is restless and sleeps less, to know the exact problem and to solve the entire problem of youth, adult, special need unemployment. Let me conclude one scholar written evidence with Beruk endeavors "An effective TVET system within a country is critical pillar of any successful economy. It can serve as the impetus to boost the value the nation and it's GDP in global market places. Effective TVET also recognizes that education and training in any country needs to be based on reliable labor market information and demand employer needs, particularly in priority trades and occupations" (MacDonald, Nink, and Duggan 2010, p.2). Implementing demand oriented goals training system into actual training practice is not easy for the TVET institution in the Africa region. The quality of the TVET institutions facilities, workshops and buildings, well organized training plans and cooperative training with industries, qualified trainers, and adequate financial resources are important indicators upon which a successful outcome-based TVET programme. On the other hand the above mention it result. September 12 at 2:55pm via mobile

Dear Berhanu I am both sad at the loss of your beloved mom caused by carbon emission related cancer, on the one hand, and extremely elated that you set out to support others not to fall traps to same problem, on the other.
Keep up your efforts to solve problems of our moms; it is great idea and hope one day you will emerge a great leader and solution man
Regards Tsegay Berhe (PhD)

My instructor Tsegay Berhe (PhD) really thanks for your constructive comment! I am a product of you, you spent a lot time for me to teach and guide me, and hence, this work is a contribution of your effort. Respectfully yours!!!