



ACADEMY OF SCIENCE OF THE REPUBLIC OF TAJIKISTAN
UNDP ENERGY AND ENVIRONMENT PROGRAM



**State and perspective of rural
energy efficiency in Tajikistan**

Situation on using of energy in rural area of Tajikistan

- Approximately 1 million hasn't access to the ordinary power service
- More than 70 % of rural area are suffering for power shortage, particularly in winter time
- Utilization of rude and inefficient ovens and chimneys for large cooking pot
- Energy-efficient technology is not practice for house building
- Rural population is forced to use the local alternative energy sources by the yxample of energy wood, which mine by the way of forest range cutting that lead to biodiversity loss, blow-out of greenhouse gases, environmental deterioration, soil erosion and increase of natural disasters risk

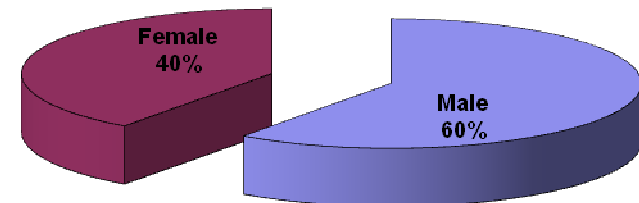


Survey

- In 2009 -2011 UNDP – GEF launched the project on "**Biodiversity Hissar Mountains**". This project involves three Specially Protected Areas (SPA) - SPA Almosi, SPA Shirkent, SPA Romit and adjoining to them population area in Vakhdat, Hissar, Tursunzade , Shahrinav
- At the initiative of UNDP Energy and Environment Programme carry out the aimed to assignment level estimation of woody tissue in the capacity of fuel and needs of rural households which lives in the abovementioned districts in other kind of energy
- Purpose: Development of strategic actions for the pressure loss to the forest (slash) by means of energy-efficient technology promotion and using of alternative energy sources in rural mountains location
- Target groups: typical households living on the territory of SPA or adjoining territories, jamoat workers, head of households
- In the whole by the research were involved 13 villages and 42 households

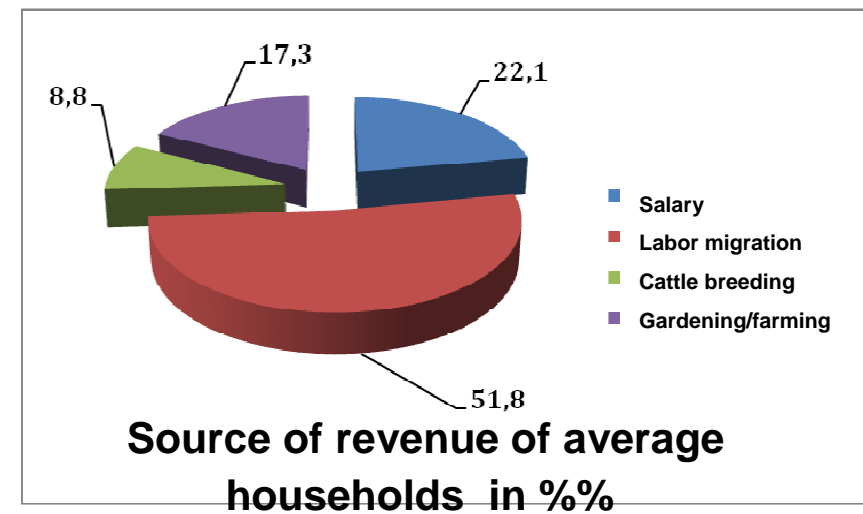
Survey methodology

- For information gathering we used inquiry which includes interview and questionnaire and focus-group methodology as well
- Gender balance was taking into account during inquiry which compose 60 % of man and 40 % of woman
- In the whole 82 respondents covered by questionnaires and 276 by interviews and conversations
- Carried out corresponding measurement and calculation of energy-efficiency of residential houses and chimneys used by households for the house heating and cooking



Survey results

- Local population mainly involved in gardening, cattle breeding and farming. Harvest and animal yield are partly used for own needs and the other part sold
- Individual households are involved in beer keeping, gathering and resource getting
- Most part of men is labor migrants who permanently migrate out of Republic which points on respective economic difficulties which local population undergo in connection with deficiency of work places
- Insignificant part of population is employed in educational sector, social sphere, forestry and industrial
- Incomes of general public of search out villages are depend on abovementioned activity



Survey results

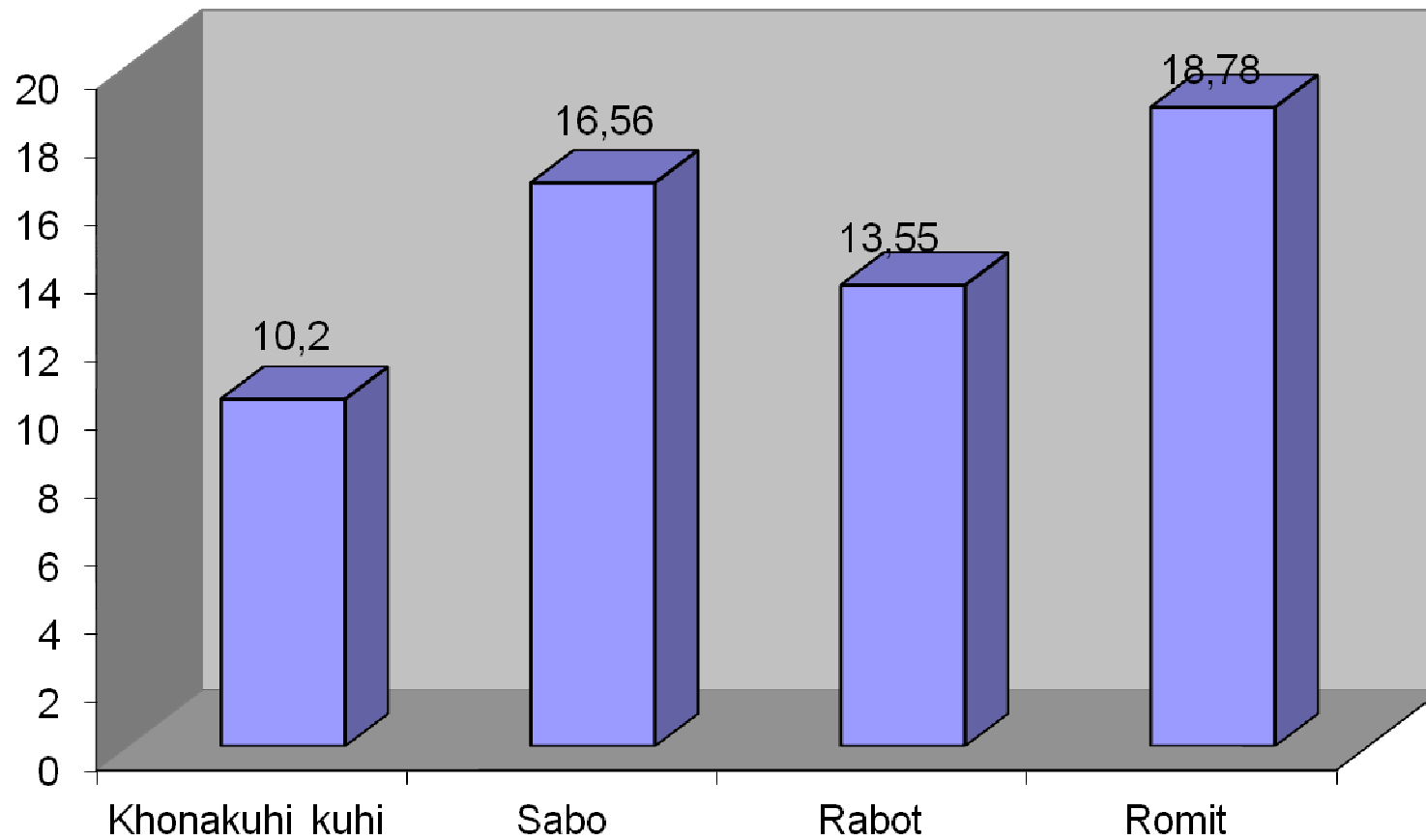
- Survey is shown that rural households needs on following kind of energy: electricity, black coal, woody tissue, pressed dung, liquid gas and etc.
- During power delivery shortage households use paraffinic candles, oil cooker and in some advantaged households use generator.
- Part of energy is purchase and other part of energy is produced by households by themselves. For example pressed dung is gathering and prepared by households, woods are mainly obtain from streamside forest.
- Coal, liquid gas and electricity is purchased by some advantaged individual households.
- In some villages power supplied in small scale from mini Hydro Power stations with capacity of 30-35 kWh.



Annual requirements of average household in different kind of energy

Jamoat (p./r.)	Wood, m ³	Coal , т	Pressed dung, т	Gas, kg	Electricity Kv /H
Romit (Vakhdat)	18,78	1,33	7444	26,7	2080
Khonakohi Kuhi (Hisor)	10,2	0,69	4822	21,7	2456
Sabo (Shahrinav)	16,56	0,62	5962	44	2538
Rabot (Tursunzoda)	13,55	0,51	8132	41,7	2494
IN all	14,77	0, 80	6590 (≈ 8,63т)	33,5	2392

Consumption level of woody tissue by average households (m3)

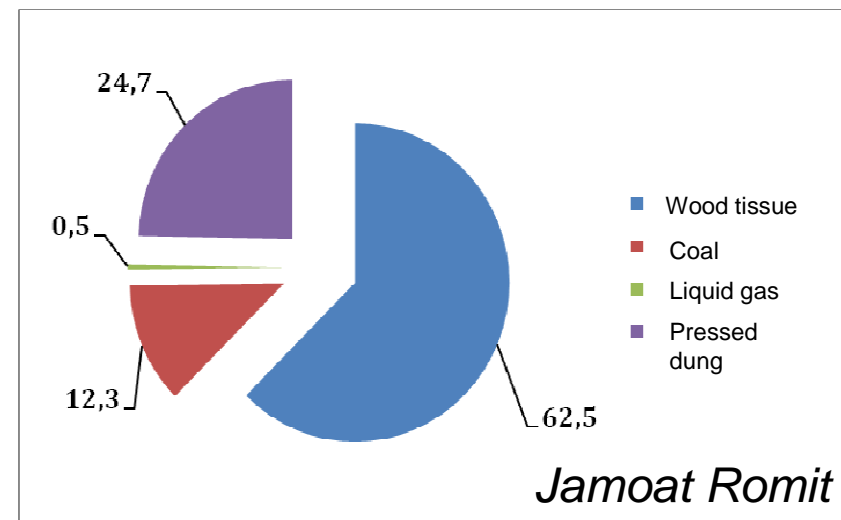
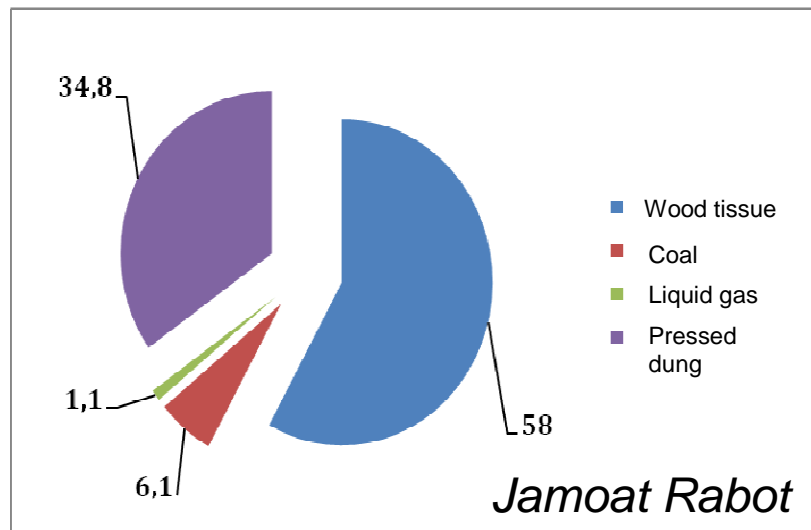
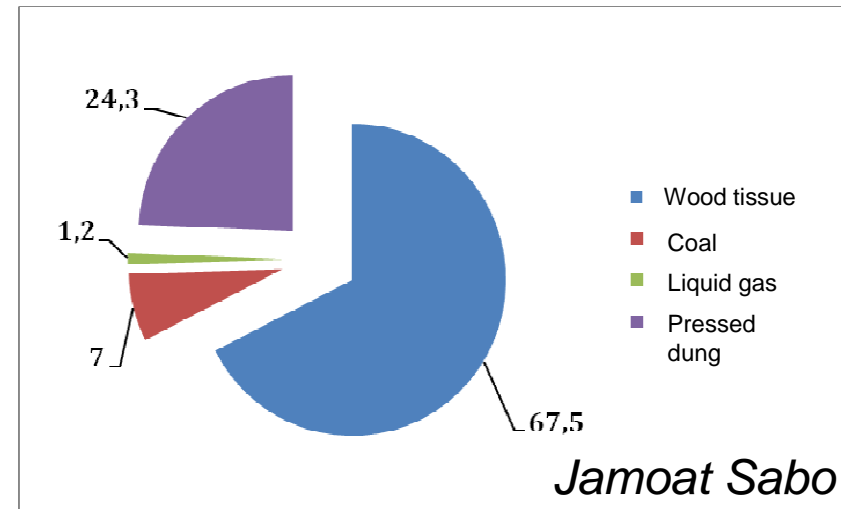
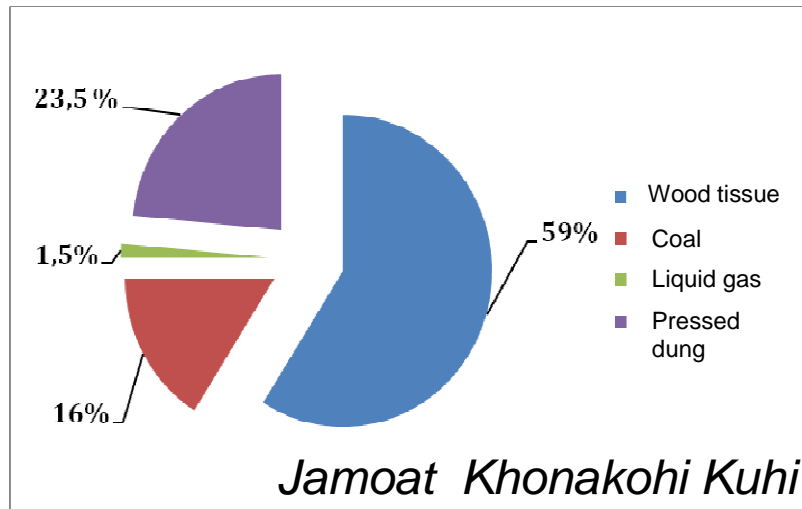


Mid-year expenses of households for purchase of different kind of energy (in somoni)

Jamoat	Wood *	Coal	Gas	Electricity	Pressed dung *	Other kind of power (candles, diesel and etc)	In total
Romit	500,0	266,7	146,7	187,2	4838,6	120,8	6060,0
Khonakohi kuhi	257,0	473,5	165	221,0	3134,3	156,8	4407,6
Sabo	375,0	282,0	226,7	228,4	2981,0	193,5	4286,6
Rabot	535,0	199,2	184,7	224,5	4066,0	175,6	5385,0
In average on type of power	416,7	305,3	181,0	215,3	3755,0	161,6	
Total, mid-year expenses of one households							5034,8 (1027,5 \$)

* minus 50% of this type of energy produced by the households themselves

Segment of woody tissue in general power balance in average households



Analysis of house conditions on energy efficiency and energy saving

Walls

- The most of researched householders has loamy walls of which 82 % wattle-and-daub, 12 % from raw brick (clay)
- You can see stone houses but in last 10 years less and less it's practiced



Camp ceiling and ceiling

For camp ceiling used balk with length to width of home, and on them lay board (leak less friend to friend) then fixed by nails.

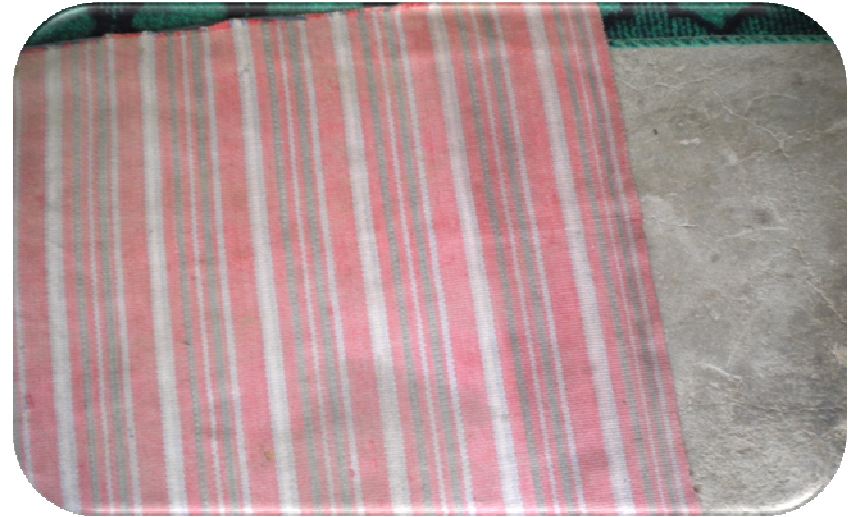
Over the boards some of households are lays layer of bush or carton and on the top they put matrix of clay and ballast stone and the last layer is plaster from cob.

The overwhelming majority households over boards without a heater layer stack a ground and over is plaster from cob.



The floor in the target households is on the ground . For the floor heating Usually used carpets.
This kind of floor construction has only cob. Its faced wood construction of floor as well.

Many houses raise on hill-sides and hills. The result of this front part of the house has floor construction above the cold basement



Windows and doors

- Windows of houses are woody with single glazing
- Exterior doors in houses has slit and some of them are not close tightly



Shortcomings in energy saving of houses

The main shortcoming of rural houses in the context of energy saving is absence of thermal insulating layer in building envelopes

Besides of this:

- Cob walls and walls from raw brick usually are fall under increased watering which reduced their heat –protective abilities .This kind of watering occurred because of unsatisfactory inside or outside plaster, deficiency of waterproofing course between the foundation and wall, transfer of precipitation to the top of the wall in the form of rain and snow, transfer of moisture to the wall thickness from the top of glass under the deficiency and bad quality outside
- Wall construction from natural stone are very massive that reduced their seismic stability. Besides of this in heat in these walls may wind up different kind of insects which constitutes a menace to the man.



- The space under the wood floor is cold in the aftermath of low heat-protective ability of basement.
- In the result the cold outdoor air intensively entered through understructure leakage.
- In the floor structure is seen interstices. In the result roof cover is leak meteorological precipitation that lead to strong humidification of garret floor.
- Absence of second layer of glazing, availability of interstice between glass and frame, frame and window sash, sash and wall



Analysis of stoves used by rural households for the house heating

- For the house heating in winter period the households used rude metallic/ cast iron stove named “cast-iron moveable wood stove”/ they heat the house very fast but when the fire is put out and finished of energy recourses supply (wood, coal,) room is get cool during 15-20 min/.
- Besides of this flue duct of this stove is like one of the straight part without smoke turnover.
- Absence of smoke turnover is come to the big loss of energy (because of straight air vent)
- Brick stove is faced very rarely in rural villages (pic)



Analyses of stoves used for cooking and water heating by rural households.

- Stove for cooking are also inefficient and doesn't respond to the norm because front part of these stoves are opened and during the cooking process or warming water part of fire flow in vein
- In the most of households house kitchen is absent the funnel and in the aftermath of it family members especially woman who are busy by cooking or water warming are affected by foul gases that exhale under the fuel combustion in these stoves.

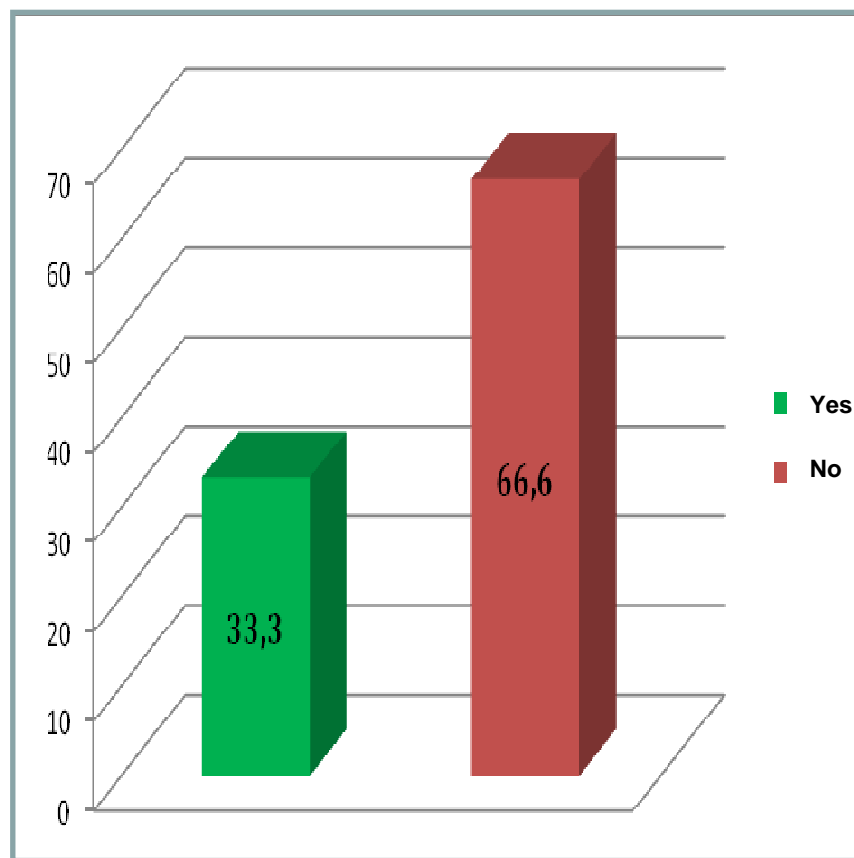


Opinion of target population about energy-supply

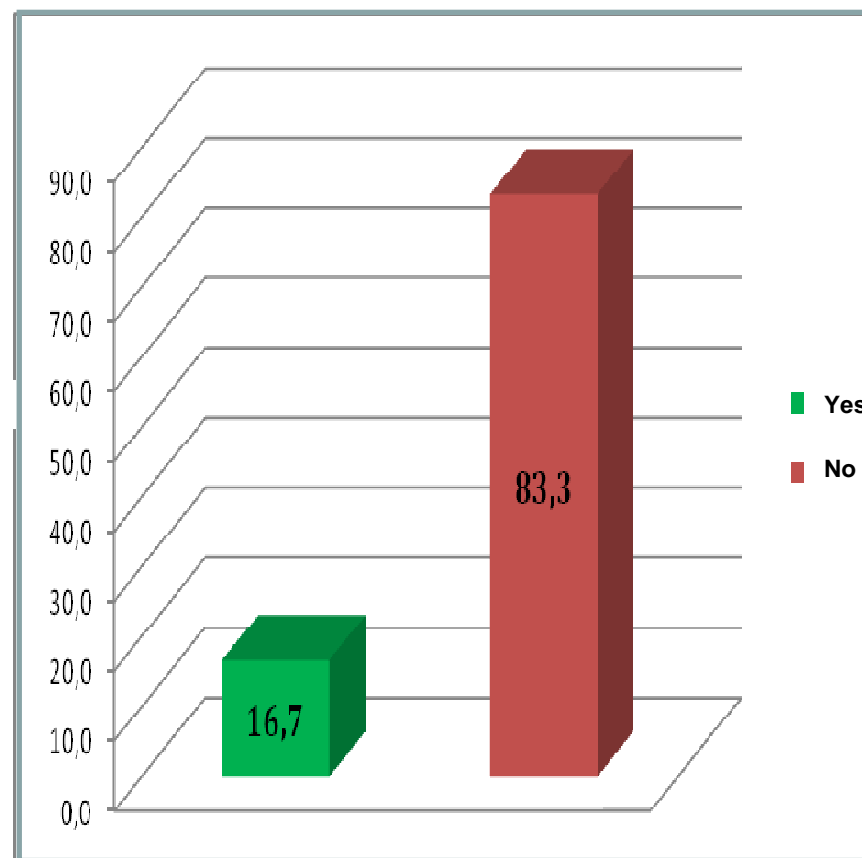
- Most of households in target jamoats, where run Power Transmission Line, are feel dissatisfactory by entered power form central power grid during whole year.
- Different villages has different grade of demand on warm water, heating, lighting. However generally is character higher demand in electric power in winter period, largest needs is reveal for warming water and economic needs of population.
- Population is unsatisfied by quality of entered power. Often power failures, voltage hunting's and tariff escalations is dissatisfy of population almost of all target villages.



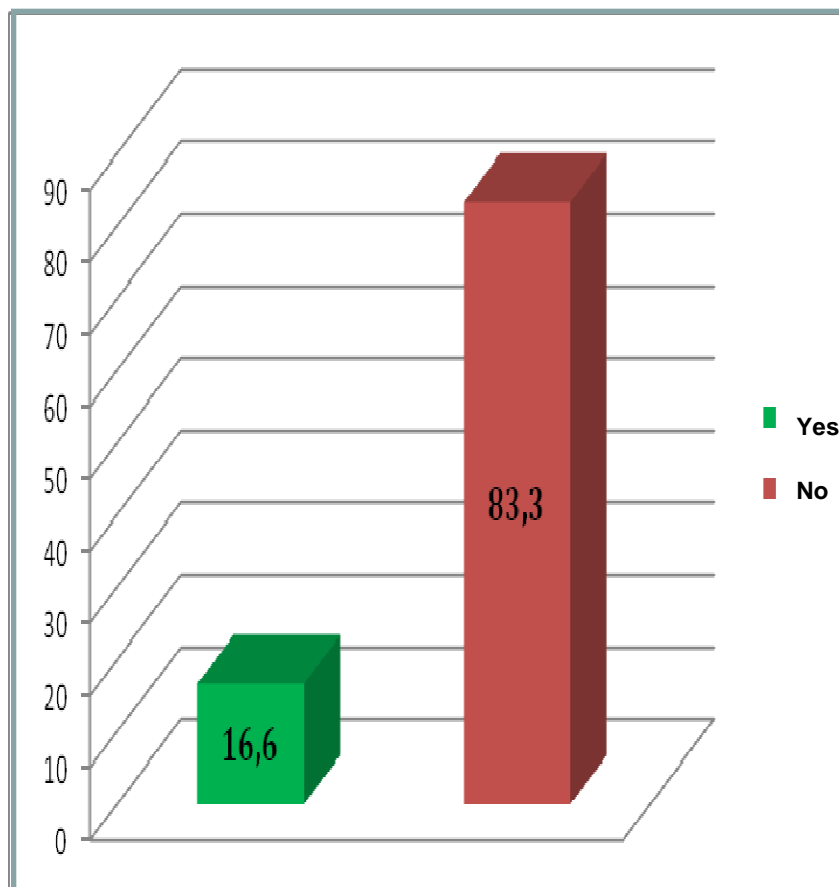
Opinion of target population about power supply



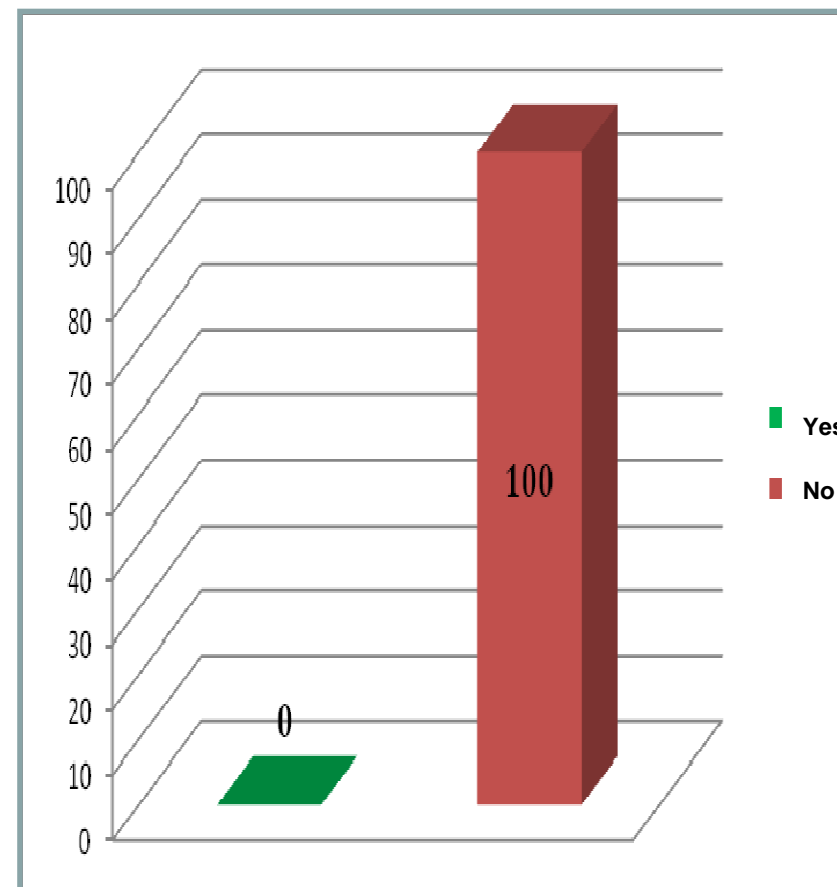
Responses of households jamoats of
Khonakohi kuhi of Hisor district
Khonakuhi kuhi (in %)



Responses of Sabo households jamoats
of Shahrinav district (in %)



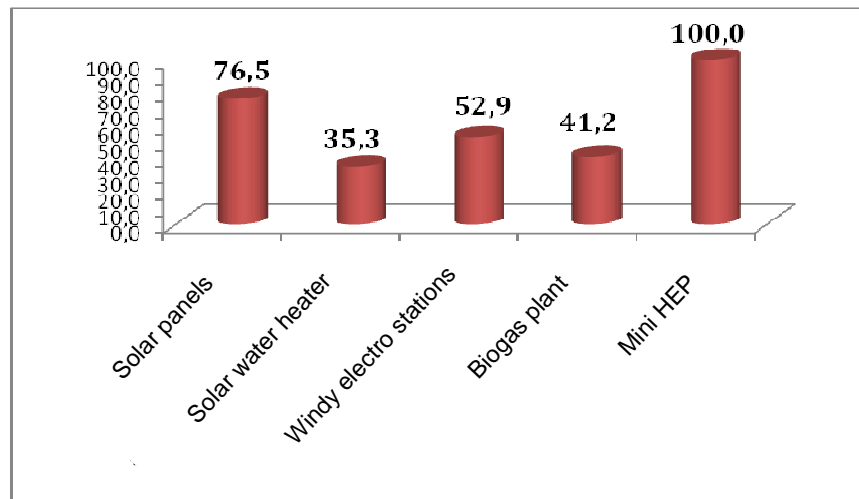
Responses of Romit jamoat
households of Vahdat district town
in (B %)



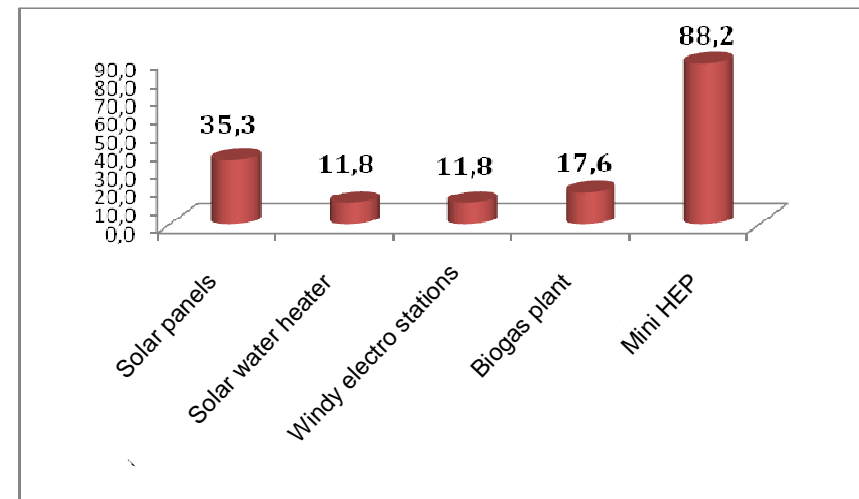
Responses of Rabot jamoats households
of Tursunzodaq district (in %)

Possibility of Alternative energy sources usage in target jamoats

Interview with target households in the frame of the present research is detect dependence between the desire of alternative energy sources (AES) and information awareness .The Research is shown that the population is not hastening to run to alternate energy resources. Main design of energy type for the households is small hydropower plants (88,2 %) and solar collectors (35,3 %)



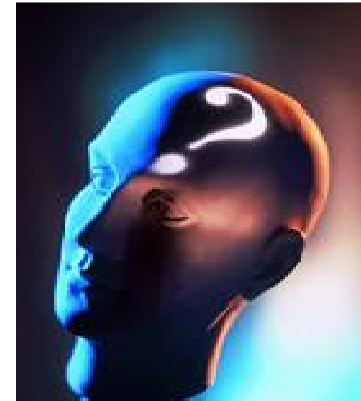
Population awareness of target jamoats about AES (in %)



Wish of target households population to use AES (in %)

Despite of existed mistrust of rural population to AES there is significant potential for development of AES in target villages, particularly in energy receiving from minor river by means of small hydro plants and solar collectors

Despite of population dissatisfaction on power using and power costs which supply by central grid , population of target villages are very carefully refer to this novation that is implementation to AES.
In many respects its connected with insufficient awareness.



Ecological and economical sustainability

- One rural households using for house heating $10,4 \text{ m}^3$ of wood and $3,5 \text{ t}$ of pressed dung in a year. Thermal isolation is lets to economy more than 50% of power fuel which used for heating that will equal to $5,2 \text{ m}^3$ ($\approx 2600 \text{ kg}$ of wood). It lets to reduce emissions of CO_2 to air approximately $4,8 \text{ t}$ Also on 50% will used less pressed dung and thereafter will reduce emission of deleterious gases to environment during its burning on 50% .
- In average one households which consist from 7-8 persons using $4,1 \text{ m}^3$ of wood for cooking , water heating , sanitation and hygiene. Energy-efficient oven is save about 30% of wood. Using of one energy-efficient oven permits to save about $1,23 \text{ m}^3$ of wood in a year ($\approx 0,615 \text{ t}$ of wood) that permits to reduce the emission of CO_2 to the air approximately $1,0 \text{ t}$

* By the burning of 1 kg of wood is exhale $1,88 \text{ kg}$ CO_2 (www.dioksid.ru, <http://www.csgnetwork.com/specificgravwdtable.html>).

- One rural household is spending 1,5 m³ wood and 654 kg of pressed dung (dried manure) in a year for the water warming and boiling
- Using of solar water heater is allow to save abovementioned quantity of wood that is 1,5 m³ (\approx 750 of wood),that allows to reduce emission of CO₂ to the air, approximately 1,4 t.
- Using of solar water heater will be caused of retraction from pressed dung application for water heating and therefore is excludes emission of deleterious gases to the environment in the burning process

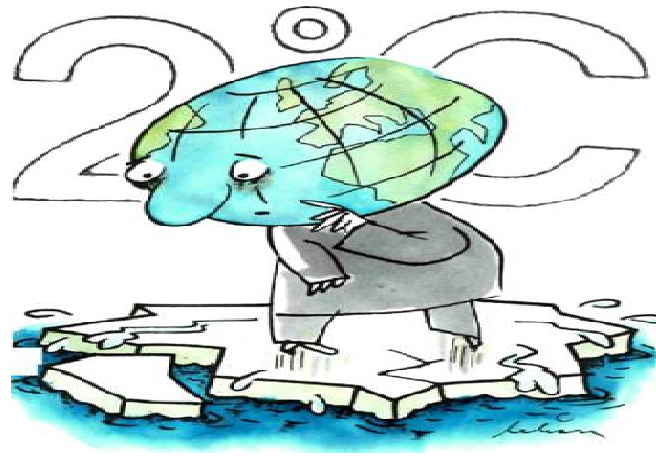


- One rural household that consist from 7-8 person is spend **14,5 m³ of woods and approximately 6590 unit (8,63 t)** pressed dung for the satisfying of energy needs (house heating , cooking , water heating for daily living needs , sanitation and hygiene). If assume that of this amount of fuel 50 % of it is purchased , fuel costs in average will compose approximately 4020 somoni (893 USD) and its without including of other kind of power costs which are necessary in living (electricity , gas, coal and others)
- These costs are essentially influence in householders budget
- Application of energy efficient and energy saving technologies permits fundamentally save family budget



* 1 cu m of wood is costs approximately 100 somonii: 1 pcs of pressed dung is approximately costs 1.0 somoni
 50% of wood are purchased and therefore $14,5 \text{ m}^3 \text{ of wood} / 2 = 7,25 \text{ m}^3 \text{ wood} \times 100 \text{ сомони} = 725 \text{ сомони};$
 50 % of pressed dung is purchased therefore $6590 \text{ pcs of pressed dung} / 2 = 3295 \text{ pcs of it} \times 1.0 \text{ сомонии} = 3295.$
 In total $725 \text{ somoni (woods)} + 3295 \text{ somoni (pressed dung)} = 4020 \text{ somoni} \approx 893 \text{ USD}$

On the result of research on household requirements evaluation in different kind of energy , studying house building envelopes and using ovens and also with the purposes of cost recovery of households to energy we recommended:



Recommendations

- **House thermal covering**

To use cheap, local and accessible thermal insulating materials: wheat straw, flax lug, paddy straw, filings, rush and other rejects. This technology permits to save 50 % of power fuel and to decrease the emission of greenhouse gases on 50 %



- **Energy efficient ovens for house heating**

The advantage of energy efficient stove under the German technology is that it is built of bricks that store heat and give it to two premises evenly and heat in the room will stay for a long time. At this time the stove can cook food or boil water. Also, to the stove can be built the oven structure and it may bake bread or confectionery. Lifetime of this technology is 25-30 years. Another feature of the stove is that fuel consumption on using is reduced on 30%.

Energy-efficient oven for cooking

Its recommended to introduce energy efficiency oven by Nepal technology . This kind of ovens are erect mainly from clay with wool, manure , chopped straw and water. The advantages of these ovens is consist in that by one fire may use and prepare in two large cooking pot in the meantime. Effectiveness compose 30%.

Solar water heater

For the water heating households used chimney under large cooking pot in the yard. If any solar water heater is no necessity for using woody tissue and other type of renewable energy sources. Also is reduce the amount of greenhouse gases that may generate In the course of usual chimney under large cooking pot and burning there the fuel. Its recommended to install single circuit and dual-circuit solar water heating.

Development of potential

- In each 4 target jamoats were conduct theory workshops on “Energy efficiency and energy-savings in rural households ” topic.
- In the course of workshop conduction used interactive methods: : brainstorming, teamwork , role play,discussions, playing exercises
- The purpose of workshop was awareness raising and knowledge level of local communities in energy efficiency and energy savings, alternate energy resources and their application ;legislative and regulatory enacts which regulates energy efficiency, energy-savings and AER.

- In conducted seminars were involved rural population and local foremen, representatives of local executive body of state power (jamoats, village committees), jamoat support centers
- 20-23 person participated on each seminar.
- During seminar conducting is considered gender balance
- In the whole in seminar participated 86 person, from which 46 men и 40 women



- In average level of knowledge before seminar conducting on energy efficiency and energy saving were equal to 39,5%.
- Upon seminar completion the level of knowledge increased twofold and compose 83%.



Illustration of energy-efficient technologies

Erection of energy-efficient ovens for heating and cooking jointly with rural population



- Thermal covering conduction of building envelope : floor , ceiling , windows, doors
- Solar water heater were installed in households.



Future plans

Creation of consulting-educational resource centers for local population – power consumers in target jamoats, which fulfill the role of the center which spread of knowledge, informing and advanced technologies in the field of efficient consumption and efficient use of power





THANK YOU
FOR ATTENTION !

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