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Social and Environmental Analysis of Decentralized Energy System and Its Future Prospects

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Abstract**—**Energy is the key driver and frequently assume their role play as a catalyst for the sustainable development. Universally the per capita consumption of energy is frequently utilized as a guage for the economic and sustainable development of any country. Sustainable Energy plays a critical part being an imperative segment for the social values, energy poverty eradication and economic development, The huge inadequacy of power because of substantial dependence on imported fuels has turned into a noteworthy obstacle to economic and sustainable growth of any developing country in general and to particular in Pakistan. This situation makes an expansion in nearby fuel costs and cutoff points possibilities in the foundation of new industries. The ongoing gap between the demand and supply of power in Pakistan is around 7000-8000 MW with a consistent increment of 6-8% per annum. Consequently, hence to overcome this situation, sustainable power sources are intensely required to conquer the current issue Pakistan is blessed with enormous sustainable power source assets, for example, wind, sunlight based, hydro, and bio-mass. These resources have the tendency to be major contributors of future energy creation framework, climate change minimization, energy decarboniztion, energy independency, sustainable growth and development of the country. This research narrates the alternative energy resources like renewables, to inrease energy efficiencies and related possibilities for full-scale advancement which can be viable for sustainable development.

Keywords**—** Climate change, Energy Poverty, Social Values, Energy Decarbonization.

I. INTRODUCTION

Energy is viewed as a preliminary operator in the generation of wealth and furthermore a signicant factor in the socail, economic and sustainable development [1]. The significance of energy in economic development has been perceived all around, the historical data authentify a solid connection between the accessibility of energy and financial actions [2].meanwhile the past two decades the risk and reality of ecological deterioration have sort out to be more clear. increasing trends of environmental issues is just because of a blend of a little elements since then the innate effect of human activities has developed extremely in view of the sheer addition of total populace, usage, mechanical action, and so on. Accomplishing answers for ecological issues that we are facing today posses hard work potential activities for practical improvement. In such way, sustainable power sources seem, by all accounts, to be the a standout amongst to be the most efcient and compelling allignments. That is the reason there is a cozy association between sustainable power source and supportable advancement [3]. Pakistan is a standout amongst the most populated nations in the southern Asia area, contributing approximately2.56% of the aggregate worldwide populace [4]. The nation is normal to fill in as a universal exchange and energy hall in the not so distant future because of its energy area [5], [6]. Thus, among other social, economical, and political variables,Pakistan needs to guarantee its energy supplies meet the immediate and roundabout requests of the nation not just for keeping up economics development yet in addition for supporting local and worldwide financial activities. The immense shortage amongst demand and supply of power recorded in 2009-2010 was 26.82%: This figure has expanded up to 50% during the late spring of 2012 [5]. A normal issue is that power supply can't be kept up during peak hours, bringing about continuous power shutdown (load shedding) of 1314 hours in urban zones, and 1619 hours in country territories. Therefore, numerous business visionaries and industrialists have contributed and moved their organizations to neighboring nations [6]. Subsequently, short-and longterm measures are needed to comprehend the current energy issues. The current situation with Pakistan's energy assets is abridged (Fig. 1).

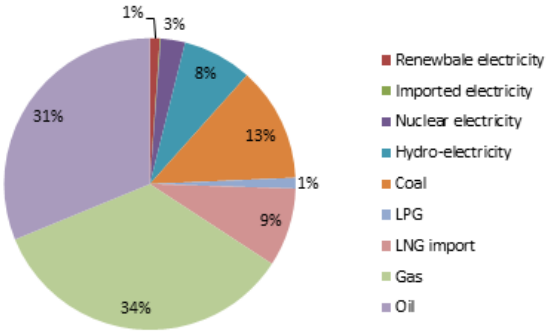

Figure 1. Energy Supply Mix of Pakistan [5]

It can be seen that indigenous energy sources essentially comprise of oil (34 %), renewable (1%) hydro (8%), gaseous petrol (27%), and coal (3%) [5]. Economical supply of energy to match the present and future household and large scale demand in Pakistan will depend on potendemand in Pakistan tail energy production from the distinctive energy sources with a specific end goal to make noteworthy commitments to the production network. current energy generation has an enormous economics related potentials on the nation's economy due to the imports of oil to help existing energy mix, and the circumstance is uplifted by the quick depreciation of household gas resources. As per the Board of Investment Pakistan, the introduced control limit is 22,797MW: Nonetheless, current age remains in the vicinity of 12,000 and 13,000 everyday, against top a request of 17,000 to 21,000MW. Figure 2 shows Energy is the principal link between human and planetary human being [6]. The real elective energy assets bottomless all through the pakistan are solar based, wind energy, wood and biomass, and biogas generation. In making energy nutilization practical and adequate to other financial parameters of improvement, the accompanying factor must be followed into consideration [7]:

- Sustainability of the biological system through suitable and appropriate asset administration;
- Economic and money related manageability through framework and administration headway that keeps reasonableness altogether to the front in view of the impeded rustic populaces;
- Social supportability through affirming that the poor advantage, and that ladies' salaries and concerns, legitimate rights for all, and youngsters' rights are altogether valued and upheld;
- Administrative supportability through guaranteeing that there is managerial limit with respect to program usage, and that this will be kept up or expanded after some time.
- Energy is the principal link between human and planetary wellbeing. In this regard, micro-hydropower is clean and environmentally sounds technology. Setting this framework, and debating the social value of energy services Pakistan is one of the countries who is also meeting with the issue of extreme energy crises.

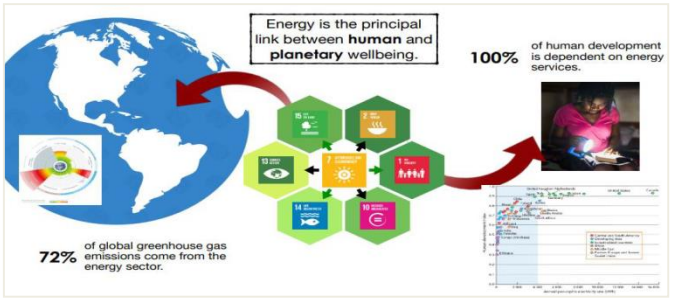

Figure 2. Energy is the principal link between human and planetary human being [6]

A. *Domestic Fuel used in Pakistan*

Current measurement, proficient, social, and creative slanting way act enormous challenges to the whole deal viability of the overall imperativeness system [6]. In case lawmaking bodies don't diagram approaches past those starting at now existed and masterminded among now and 2030, it is evaluated that [7]: imperativeness use will increment by completed half (53%); the energy mix will remain truly enduring and powers (80%share); vitality related CO2 releases will augment by completed half (55%); huge peoples of the world's poor will regardless continue having nonattendance of accessto control (around 1.5 billion) and present day cooking and warming organizations (around 2.5 billion). In this circumstance, vitality use increases from 12,467 million tons of oil proportionate (Mtoe) in 2008 to 14,765 Mtoe in 2020 [4]. Over 70% of this advancement is required to start from making nations, which overpower OECD countries as vitality customers sooner or later around 2014. About segment of the improvement in world fundamental vitality use goes to conveying force and onefifth of the expansion to tending to transportation needs [8] [9] [7]. Improvement in vitality usage and GHG releases is depended upon to be especially engaged in a couple of zones. The sectoral quick supporters of improvement in vitality utilize are required to be control age (35%), industry (15%), transport (12%) and structures (6%) in making countries, trailed by control age (11%) and transport (6%) in OECD countries [8]. proficienting profitability and declining carbondioxide (CO2) drains should percieve early thought in these high improvement areas, in light of the way that these goals are caught and down to earth to accomplish at the period of new advancement than at later retrofit stages. It is foreseen that the world Energy mix will remain really unfaltering and instructed by oil based goods to 2030 in view of the edge and latency of the vitality structure and the inability to modify it hastly. In such case, no fuel's offer of the mix alter by more than two or three rate centers in current situation. Oil subordinates remain the greatest and humble vitality source speaking to about 80%of overall demand in 2008 and 78% in 2030 [10]. The usage of each non-sustainable power source creates at different eras and rates, so their offers of the total move springily oil tumbles from 34% of the total in 2008 to 32% in 2030; coal rises from 25% to 26%; and gas climbs from 21% to 23%. Stresses over continued with high usage of oil and gas.

II. SOCIAL VALUE OF ENERGY SERVICE

A. Energy Demand and Poverty Alleviation

Energy adds to an upright cycle of human, monetary and social changes that are major to sensible change in making countries alluding. Sufficient supplies of clean energy are the explanation behind raising lifestyles, upgrading the quality besides, measure of human capital, enhancing the business and customary condition, and extending the capability of government courses of action [11], [12]. In any case, energy dejection remains a vital issue for human prosperity, money related headway and environmental reasonability in various parts of the world. Around 1.6 billion people generally in the natural districts of Sub-Saharan Africa, South and East Asia, and Latin America require access to control, and 2.5 billion people rely upon ordinary biomass for cooking and warming [10] [12]. Around 1.3 million people generally women and children kick the pail imprudently consistently because of introduction to indoor air defilement from cooking and warming with coventional, inefficient biomass stoves (see Fig. 3). Enthusiasm for energy is growing exponentially in making countries in view of fast people improvement (especially in Africa) and snappy financial advancement (especially in China and India). This is foreseen to provoke a nearby duplicating in basic energy use, a considerable amount of it unsustainable, by making countries in the accompanying two decades. As a result of this advancement, making countries will speak to 50% of basic energy use and 52% of energy related CO2 releases constantly 2030 [13], [14], [15]. China will experience the best addition in energy request, speaking to 43% of all making country improvement and 30% of signify world advancement. India, other Asia, the Middle East and Africa will show medium advancement in energy usage [12]. Concerning energy sources, coal will be the greatest creating energy source took after by oil. Gas will continue being used extensively in the Middle East and Latin America, while the use of biomass and waste will increase in Africa [13], [12]. Massive endeavors are required in additional and substitution restrain concerning making, evolving over, transporting and dispersing energy in making countries to address future issues. Most of this wander is required in the power fragment, particularly in China, India and other Asian countries . Diverse locale require financing furthermore for oil and gas change and use [13]. Then again, hypothesis at these strange states addresses a twofold test. Governments need to set game plans that draw in sufficient private theory and change help. Making country governments, together with theorists and advocates, need to find more capable and more moderate techniques for passing on energy benefits so the money related save assets might be placed assets into other sensible progression needs. They should in like manner ensure sensible cases of age and usage of energy supplies and organizations [16]. capable and more moderate techniques for passing on energy benefits so the money related hold assets might be placed assets into other achievable progression needs. They should similarly ensure sensible cases of creation and use of energy supplies and organizations [14].

B. Sustainable and Viable Energy Sources

Lack of access to moderate power and substantial dependence on the wasteful and unsustainable utilization of conventional biomass energizes (i.e.,fuelwood, charcoal, agrriculture waste and animal dung) are the two appearances and reasons for neediness. Power and other present day energy sources assume a basic part in economic and social improvement. Only they can't mitigate destitution however they are key to supportable improvement [17]. Present day energy administrations upgrade the life of the poor in incalculable ways. Electric light broadens the day, giving additional hours to perusing and work. Present day cook-stoves spare ladies and kids from every day introduction to poisonous cooking vapor. Refrigeration broadens nourishment freshness and dodges wastage. Centers with power can disinfect instruments and securely store prescriptions through refrigeration. Assembling and administration ventures with current energy can be more profitable and can expand the quality and scope of their items along these lines making employments and higher wages [9],. In numerous nations, neediness is drawn out especially by the unsustainable accumulation of biomass and its utilization in customary, wasteful stoves [18].This makes indoor smoke contamination prompting genuine wellbeing harm, for example, respiratory illnesses, obstetrical issues, visual impairment and coronary illness. It requires extensive sums of time for fuel gathering diminishing the time accessible for other profitable exercises, for example, cultivating and training . It causes biological harm (e.g. deforestation and soil disintegration) and nearby shortage of wood in a few regions. What's more, it draws horticultural deposits also, manure far from their utilization as compost, in this way decreasing agrarian profitability [18]. It is assessed that to accomplish the Millennium Development goals (MDGs), the quantity of individuals lacking power would require to decline to beneath 1 billion and those depending on customary biomass would need to tumble to 1:2 billion by 2015. Deliberate government activity with help from the industrialized nations is expected to accomplish these objectives, together with expanded subsidizing from both open and private sources [17]. Then again, arrangements need to deliver obstructions to access, reasonableness and supply of power and elective energizes, which are as of now accessible at sensible cost, e.g. gas-let go stoves and barrels. Access to practical energy sources should shape a focal part of more extensive advancement methodologies [19], [20], [21].

III. ENERGY RELATED CLIMATE CHANGE POLICIES

A. Transformation of economic instruements

Economics or "market based" instruments can be a successful and economically proficient methods for accomplishing feasible and sustainable policy objectives much of the time. These incorporate taxes, outflow exchanging, appropriation change, and special duties. Then again, economically viable instruments offer the potential for both static effectiveness and dynamic proficiency. They give expanded adaptability to governments and industry through

expanding on the activity of the market and the value framework. They can give government income that can be utilized for an assortment of purposes [2, 20]. Ecologically related assessmentspresent value flags so makers and buyers consider the expenses of contamination and asset utilize related with their exercises. Thusly, carbon assessments would disguise the cost of ozone depleting substance emanations and raise the cost of specific energizes, procedures and items. These financial motivating forces would decrease interest for hurtful items and increment interest for elective powers, for example, renewables whose costs turn out to be more focused. Ecologically related expenses additionally increment motivating forces for the private division to embrace R&D on supportable advancements and further advances. Worry about diminishing the aggressiveness of energy escalated parts is a noteworthy snag to the full execution of carbon charges. energy escalated enterprises regularly get aggregate or fractional exclusions from such expenses despite the fact that huge worldwide decreases in carbon emanations could be accomplished. In collecting carbon imposes, the compete based effects can be diminished by:

- Enlarging and extending and make the group of countries that put similar,affordable and parallel policies in place,
- requiring outskirt charge modifications on items from nations having Less stringent expenses,
- Recycling a bit of the duty incomes back to the influenced firms Numerous nations are currently considering such methodologies for utilizing carbon charges to advance more sustainable and viable energy framework

B. Clean Development Mechanism (CDM)

Under the Clean Development Mechanism (CDM), industrialized nations can accomplish some part of their required ozone-depleting substance duties under the Kyoto Protocol from ”credits” produced through lower-cost outflow diminishments in ventures past their own fringes. Governments, financial specialists and privately owned businesses in industrialized nations can get credits for lessening ventures they do in ”have/merchant” nations. Each CDM venture must [21] [8] [22]:

- diminish GHG discharges well beyond ”nothing new”;
- represent GHG discharges that happen outside the undertaking limit that are inferable from the task;
- hold fast to strict physical limits inside which GHG discharges will be decreased;
- not include atomic innovation nor surpass universally concurred restricts on ranger service credits and exercises;
- be deliberate and have the host nation’s endorsement;
- meet the manageable improvement objectives characterized by the host nation;
- incorporate the support of influenced networks, gatherings or people;
- not add to ecological decay;
- happen in a creating nation that is Party to the Kyoto

There has been a fast development in action under the CDM, which is as of now anticipated that would prompt discharge alleviation of in excess of 1.8 billion tons from more than 1700 individual undertakings by 2012 [23]. Be that as it may, in spite of the fact that there is a colossal potential for sustainable power source and energy proficiency ventures, quite a bit of it stays ”undiscovered”, with these undertaking composes representing about a fifth of aggregate expected credits from the CDM. There are a few explanations behind this at the national, universal and undertaking levels, including constrained institutional limit, challenges in getting adequate venture back in nations with a high sovereign hazard, and the generally little size of numerous sustainable power source and energy proficiency projects [6]. The sectorial crediting system (SCM) would center around financial areas, as opposed to ventures, in creating nations.E mission execution baselines for a predetermined period would be set up for chosen divisions (e.g. iron and steel and concrete) in partaking creating nations. These nations would then get tradable discharge decrease credits, which they could use as they wish appropriating them to singular organizations in the area or offering them for general income [24, 25]. Sectorial attributing components are a promising intends to support interest in atmosphere well-disposed energy frameworks. By the by, building up a compelling framework that is achievable to arrange and set up presents certain difficulties because of wide varieties in ozone-harming substance forces among nations and offices, and the requirement for specialized aptitudes for assessing, checking and confirming sectorial crediting proposition. The interest for credits must be moderately sure to try advantageous, and the ecological adequacy of the instrument must be anchored.

The main reason of the dismantled plants was maintenance. The plants constructed with government subsidy were dismantled. It was observed during the visit that there were only two types of the plants installed in KPK. In which 60% of the plants were fixed dome plants. While 40% of the plants were floating type. It is worth noting that the plants installed by PCRET with the government subsidies were floating type.

IV. METHODOLOGY

A. Descriptive Analysis

The collected data from the households were entered into the Statistical Package for Social Scientists (SPSS). For this, we have taken two samples, the first one for 100 households connected to the central grid and the other 100 sample of household’s connected to MHP. Then study the result of each sample independently through the statistical package. The data of family unit size and limit, a source of money and area of agricultural and ripe land, and so all were passed into SPSS. Different factors like the primary source of lighting, accessibility of power in 6 hours, month to month bill and association costs, and so all were examined. The fulfillment and Gratification level of family units with respect to the MHP power and WAPDA power was additionally broke down and assumed about. In this study, the expansive fuel for cooking and

heating was similarly analyzed. Other sources of energy for lighting purposes such as generators, LPG, UPS, Kerosene oil, and DC chargeable lights were added for the analysis. All the analysis was done for the two entities on the basis of electrical energy they are using. Besides, the additional use and costs made by WAPDA clients are likewise anticipated. the relative cost of unit capital cost (Rs. /kWh) and unit electricity cost (Rs. /kWh) of micro-hydro power is calculated. We also consider unit electricity value per kilowatt-hour of WAPDA. The capital cost is resolved depends on the underlying capital expense of the plant and its absolute introduced limit kilowatt. The electricity cost is determined by separating the fixed every month bill on the absolute units expended every month in kilowatt-hour.

B. Economic Analysis

The economic analysis includes looking at the doings and cash flows of a commercial or business firm, public organization or assembly of the association. The aims of economic-related analysis are to update the partners required, to regulate the economic system perfectly, and to illuminate contributors and open organizations. The yields of this investigation are the income of elements, return on investment, and working expenditure plans of people and measures of distant promises required. Financial investigation of the task relates the advantages and expenses to the industry. It considers the market costs and expenditures to decide the parity of assumption and the manageability of the undertaking Economic Analysis and furthermore assesses the surges of assets among gatherings of different groups and their impact on society all in all. Cost-effective investigation evaluates projects from the assessment of the community completely (the host country economy). It compares the expenses and profits of the total economy of the country. The economic study depends on the opportunity cost of the benefit. It also depends on market value and the demand for customers available in the market. The opening price replicates charge of using limited assets of the community. On the other hand financial study practices commercial amount that is changed from marketplace bill by discounting tax, return and grant, etc. This inspection is projected on excel spreadsheets. Facts and figures that were used for this investigation is preliminary investment charge of Micro hydropower plants, operational and repairs cost and total charge. These statistics were achieved over the initial investigation after the owners of the electrical power plants. The paybacks of the project and the prices gathered from the families and owners of industries and facilitate workshops which use the electrical power by Micro hydropower projects. The data of profits in regulatory rapports were passed in into the excel sheet.

C. Environmental Analysis of Distributed Energy

As solar and hydro generate clean energy and produce no greenhouse gas emissions. Therefore the installation of these projects will also contribute to the protection of environment and the renewables will replace the use of fossil fuels which produce GHG emissions.

D. Energy baseline and its improvement

Energy baseline is the source of energy, which is used in the rural areas in the absence of project activity. The emission baseline is analyzed by using the aggregate of annual kilowatt-hour output of all the micro-hydropower plants times the CO_2 emission factor for the fuel displaced.

Electricity generation per annum kwh/year = plant capacity factor kW

Annual CO_2 emissions tones of CO_2eq = power generation kwh/year * emission factor tones of CO_2/ kWh.

To find the total emission reductions, calculating the total annual energy generation by summing the installed capacity of each micro-hydropower plant in hours, then multiplies this with the emission factor of the displaced fuel which is diesel. After that convert it to tones of CO_2eq and the formula is given below,

Kw* hours* 1.83 kg CO_2eq /kWh = tone of CO_2

An emission factor of 1.83 kg CO_2eq /kWh is used for this analysis.

E. Research Design

This analysis is established in a descriptive investigation scheme. The research is focusing on the socio-economic aspect of micro-hydro projects in remote areas. This research shows how benefit takes benefit from the project and use energy for economic activities. The study is focusing on the social and environmental impacts of distributed energy before and after the installation of micro hydropower projects. Energy is not only part of our society but nowadays it is considered as a multitrillion-dollar business hub.

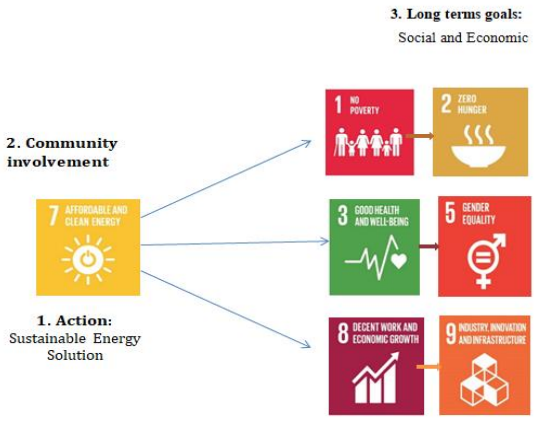

Figure 3. The Social Value of Energy Services [Research design framework]

In rural areas, there is no productive use of energy mostly people use electrical energy for lighting and cooking purpose. The projects installed by the PEDO and SRSP are less effective and has no sustainability. The community involvement is the basic issue and also the financial and social structure is not defined. Linking the community involvement (affordable and clean energy) with the social and economic analysis (SDGs 1, 2, 3, 5, 8, and 9) is the basic framework and the baseline for the

social value of energy services. By bringing full time solar energy and environmentally friendly storage to villages the project offers affordable and clean energy (SDGs 7 and 13). Using local renewable energy sources keeps money in the community that w ould otherwise be spent on the purchase of power and fuels elsewhere. Harvesting local energy will reduce poverty in the community (SDG 1). The revenues generated and the availability of power will allow for economic growth and work in appropriate, well-lit and heated or cooled, depending on the season, circumstances (SDG 8) while training young people to help multiply the concept. Being able to work in decent circumstances will help maintain health and well-being, while the electrification of the local health centers for people as well as animals will help to improve general health in the community (SDG 3). Electrification of the local schools will allow for quality education, while the training programs necessary to build, operate and maintain new microgrids increase education leading to good jobs (SDG 4). Better chances for education improve the chances of girls and women to participate in social life and employment (SDG 5). Decreasing the dependency of power and fuels imported to the community reduces the risk of conflicts and increases the chances of peace (SDG 16). The availability of power will likely reduce the risk of food perishing, reducing the risk of hunger (SDG 2). The introduction of solar based microgrids combines with storage provides the necessary energy infrastructure for rural communities to thrive (SDG 9). Thriving create space for support to the marginalized and disadvantaged (SDG 10). The availability of power might create an opening for two-, three- or more wheeled electric mobility, allowing the community to leapfrog the use of combustion engine vehicles (SDG 11) and the noise, heat and exhaust fume pollution related to them (SDG 15).

V. EXPLANTORY ANALYSSI

A. social and economic results of distributrd energy system

This portion of the research presents the outcomes and experiential results that were found through SPSS. In this portion first analyzed the social and economic results of the sample and after that additional analysis is carried out.

TBALE. 1 ECONOMIC ACTIVITIES CONNETED WITH MHP HOUSEHOLDS AND GRID-CONNECTED HOUSEHOLDS

		LABOR	AGRICULTURE	GOV. SERVICE	BUSINESS
MHP (HOUSEHOLDS)	PERCENTAGE				
GRID-CONNECTED (HOUSEHOLD)	PRECENTAGE	30	18	19	16

In this analysis, the percentage of households in government service or labor is greater or less equal. Actually, the MHP homes are situated relatively in the far-flung and mountainous area; as a result of the people over, there are not reachable to the commercial and colonial work. On the other hand, the grid-connected households are reasonably thriving in terms of productive use of energy like job opportunities, business, and overseas employment. If we talk about the ownership arrangement with respect to agriculture lands here both micro-hydro users and grid-connected households are changed. Households connected to the MHP are agriculture than grid-connected households.

B. People perception and satisfaction

In this analysis, we deal with the perception and the degree of satisfaction of rural areas about the provision of electricity by solar and micro hydro power plant (MHPP) and WAPDA.

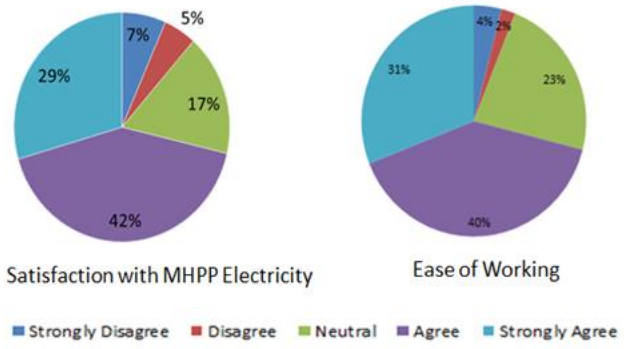

Figure 4. levels of satisfaction (Percentage of household)

Foreign employment, self-oriented business, agriculture service are the key livelihood/earnings sources of the inspection households. Supplementary profession contains fishing, hunting, daily wage, etc. The number and the ratio of survey families have shown in the table below. Greater number of families is depending on the overseas occupation. Though on the view of 45 households are connected to agriculture but then again some homes are totally hung on cultivation because agriculture is there main income sources.

The figure shows that people 23% are dependent on foreign employment. The households 40% are totally dependent on agriculture. 12% are involved in the services sector. 7% of people are engaged in their own business and 2 % are in others such as daily wages.

C. Environmental Analysis

Micro hydropower is a clean source of energy that produces no greenhouse gas emissions. The production of clean energy from micro-hydro will replace the fuelwood and kerosene oil in the targeted area and therefore will lead to the CO_2 emission reduction.

The total number of MHPs visited is shown in fig 4-8, were two major MHPs are operating and generating electricity in Kalamm valley. These plants are operating by the SRSP. MHPs plants have different capacities. Jungle inn MHPP has two turbines 200 kW each have a total capacity of 400 kW while the Ashuran MHPP has capacity of 1.2 MW. These MHPPs are of

proper design and the turbines are from a Chinese manufacturer.

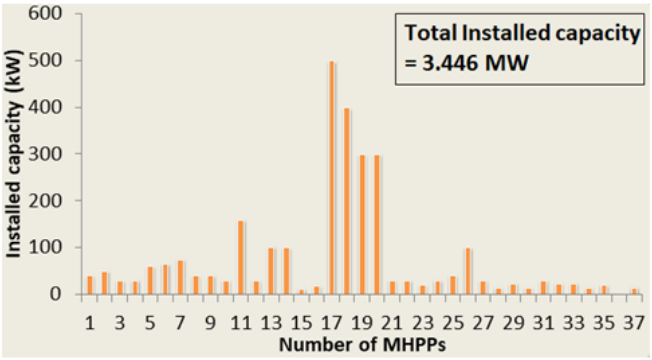

Figure 5. Installed capacity of each MHP

D. Green house gas emission reductions

This part shows the reduction of greenhouse gas emissions in the surveys area. As there is no access to the grid electricity due to the geographical location and remoteness of the area, so there is more probability of using fuelwood and kerosene oil by the local community. This will not lead only to the cutting of local forests but will also cause GHG emissions. Moreover, due to the increase in population and more demand for electrical energy, there are more chances that there will be more diesel generators in the community near in future. Therefore, the existing MHPs and expected new power plants will reduce GHG emissions. The total installed capacity of Ashuran and Jungle Inn MHPs are 1600 kW which is equal to 1.6 MW. From the survey report, it was found that each MHP power plant operates for 20-22 hours. Therefore, the average operating time per day is 21 hours. So this will give electrical energy generation in kWh per day.

Total installed capacity of the MHPs = 1600 kW

Operational time per day = 1600 kW * 10 hours = 16000 kwh/day

Month: 16000 kWh * 30 = 160000 kWh

Annual: 160000 kWh * 10 = 1600000 kWh

Therefore on annual basis the total electricity generation by the plants will be 1600000 kWh per annum.

Now multiplying this with the emission factor of 1.38 kg of CO_2eq/kwh, this gives total baseline emissions.

1,600,000 kWh * 1.38 kg CO_2eq/kwh = 2,208,000 tones CO_2eq/annum.

Now for the total 37 micro hydro sites,

Now the Total installed capacity of 37 MHPs = 3,446 kW

Operational time per day = 3,446 kW * 10 hours = 34,460 kwh/day

Month: 34,460 kWh * 30 = 1,033,800 kWh

Annual: 1,033,800 kWh * 10 = 10,338,000 kWh

Now multiplying this with the emission factor 1.38 kg of CO_2eq/kwh

10,338,000 kWh * 1.38 kg of CO_2eq/kwh= 14,266,440 tones CO_2eq/annum

VI. CONCLUSION

In remote areas of Pakistan people has no access to grid electricity mostly they spend their time in a dark situation. But the potential of natural resources like hydro, solar energy and biomass is tremendous. So by installing micr hydro or solar grid in a rural area is the ultimate solution of their poverty and social standard. The conclusion of this research is pointed: they have enriched the social and economic status of the communities. It has created new business opportunities and job for the local people. Kerosene oil was in expansive option for the people but now due to the availability of micro hydro power plants, it has reduced their expenditures. Those households which are not connected to the MHP are less developed and still use the traditional sources of energy for their light and cooking purpose. Consumption of electrical energy is highly related to high development and human welfare factor. The study hours of students have improved quite nicely and they give more time to the study because of the availability of light. Now the people are qualified and they have opened tuition academies for the children's. the use of traditional energy sources such as kerosene oil, firewood, and biogas have reduced. Energy from the hydro is the cheapest source of energy and people can eradicate poverty and improve their life standard through energy innovation in this in this field.

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