

## GEOHERMAL ENERGY FOR SUSTAINABLE DEVELOPMENT IN NORTH WEST INDIAN HIMALAYAS

R. ARYA<sup>1\*</sup>, K. MIDTTØMME<sup>2</sup>, J. MÜLLER<sup>3</sup>, R. ARNI<sup>4</sup>, R. BJARNI<sup>4</sup>, A. KUMARS,  
N. TULI<sup>6</sup> AND R. BANSTU<sup>7</sup>

*Development of the geothermal resources has the potential to supply the region with electric power, heat and cold which will increase industrial efficiency and productivity in sectors such as agriculture, food processing, tourism and mining. Still this resource in India is ignored and presently used for bathing and cooking only. An Indian-Norwegian Programme for Research Cooperation (INDNOR) has been established to promote collaboration on research and research funding between India and Norway. Present paper highlights the findings of the pre project Agneyodgara (Indor) 2011-12 "Sustainable Development of Geothermal Energy in NW Indian Himalayas" funded through INDNOR Programme. Geothermal experts from India, Norway and Iceland participate in areas for long-term research cooperation includes exploration and development of geothermal resources, geothermal plant technology, water quality, impact on the society and the environment and capacity building.*

### Introduction

Direct and indirect use of geothermal springs in Himalayas in the form of bathing, cooking and medicine to treat joint pains has been known since time immemorial. Of late these hot water springs in Himalayas are also associated with religious belief and as such its indirect use in power generation was somehow ignored. It is sad but true that inspite of having Geothermal electrical potential to the tune of 10000 MW mainly confined along the tectonic zones, India still does not figure on the geothermal map of world. Main reason was firstly

non availability of suitable drilling technology and secondly non availability of technical knowhow to tap low temperatures thermal spring and use it for various purposes like geotourism promotion, green house, refrigeration, farming poultry etc.

Present study is based on "Agneyodgara" (LAVA energy) concept developed by R. Arya with the aim to provide right to free safe sustainable water and Energy for all. Agneyodgara Indnor is taken up as Joint venture between India and Nordic countries to study and document geothermal springs in Himalayas and suggest various geothermal applications which these springs can be used for sustainable socio economic development of the region.

\* Corresponding author e-mail : aryadrillers@gmail.com

- 1 Arya Drillers, 405,GH7A, Sector 20 Panchkula Haryana, INDIA
- 2 Norwegian Geotechnical Institute (NGI), NORWAY
- 3 Institute for Energy Technology (IFE) NORWAY
- 4 Isor ICELAND
- 5 Sathaj Jai, Vidjaj Nigam Limited (SJVN), INDIA
- 6 Center of Advance, Studies in Geology, Panjab University Chandigarh, INDIA
- 7 National Institute of Technology Hamirpur (NIT), INDIA

### In Himachal and Ladakh

Himachal is considered to be land of gods because of various reasons and occurrence of Hot water reservoirs springs was also considered to be a miracle and religious places flourished in and around these places from tales which since time immemorial passed from one generation to another glorifying the person who knowing or

unknowingly discovered those springs. Saint Vashist and Guru Nanak Ji are credited for discovering and utilising the hot springs in Vashit near Manali and Manikaran near Kulu. Since time immemorial millions of people have taken (religious) bath in these kunds (collected water bodies) and knowingly or unknowingly utilised these hot water resources for their day to day use. Indirect use of these gysers was started in early 16th century when Guru Nanak Ji first used these spring water to cook food and since then food cooked on these hot water springs is distributed free of cost to 1000s of people everyday who come to visit this religious place. In Ladakh Geothermal springs have been used by traditional doctors (Alchi and Amchi) to use these resources for treating patients to cure them for joint pains. So direct and indirect utilization of this resource for bathing washing cooking and medicine has been done since time immemorial. Geological survey of India made some efforts to develop geothermal power upto 5kw in Manikaran but failed as landslide destroyed the turbines. In Puga also geothermal wells were drilled but are abandoned for reasons best known to the officials.

In Chumathang pilot project is done by one of us (R. Arya) to have direct use for space heating the room for army. Pilot project can however be initiated to make Chumathang the green cantonment using the geothermal energy source.

### Field Excursions

Detailed field excursions were made in Manikaran, Tatapani and Rampur in Himachal Pradesh and Puga, Chumathang and Panamic in Ladakh. Qualitative and quantitative analysis done to study various geochemical parameters so that subsurface information of the geothermal springs can be known. Efforts of Geological Survey of India will be restudied and their failure in non generation and non utilisation of geothermal resources for direct and indirect uses were studied. Ways and means suggested to use these resources in a sustainable way so that it boosts the socio economic status of the people living in remote areas.

### Activities Planned

would be up in Manikaran to show the historical development of geothermal energy development in India and abroad. In Tatapani most of the known resources will be submerged under the Hydro power dam. Studies would be conducted to show how thermal springs can be explored and developed in alternate sites so that geothermal tourism can be promoted by developing beautiful swimming pools and spas. Greenhouse and cold storage plants are planned based on tapping geothermal energy resources so as to provide sustainable source of income to the people of Ladakh living in inhospitable conditions.

### Interaction with Government

Utilisation of geothermal resources for direct and indirect use will be the basis of the research project aimed to document proper utilisation of the geothermal resources in the Himalayan region.

It may be mentioned that present state of affairs in the government fails to recognise geothermal as a resource for socio economic development as a result the hot springs are used for bathing and washing clothes. Most of the geothermal sites do not have proper infrastructural facilities to take proper bath for women and children eg in Tatapani in Himachal. In Manikaran the resource is used for cooking and bathing but systematic use of this resource in space heating can be of great use in actually warming the floors of rooms and keep the devotees visiting these places warm even in winters.

### Geothermal in War and Peace

Ladakh is strategically important place because of its borders with Pakistan (Western side) and China (eastern side) Kargil war and Siachen conflicts are still fresh with Pakistan and recent intrusions of China in Daulatbag sector and occupation of Old Demchuk and parts of Chumur after 1962 conflict are still creating political ripples. Due to its geographic location and temperate climatic conditions area remains cut off from the rest of the world for more than 8 months. Therefore need to store fossil fuel in summers to use in winters gains importance.

Experiments will be conducting by drilling borewells in sub surface to get the feel of sub surface geology and study different factors controlling the movement of thermal springs. In Manikaran methods would be suggested to redevelop a low thermal power plant upto 5kW as a demonstration pilot project for suggesting utilisation of this resource for power generation which was abandoned by GSI following a landslide. A museum of geothermal studies

Presently border areas in Ladakh are using fossil fuel to meet the basic energy requirement for heating water for bathing and washing clothes. In winters when temperatures drop to minus 30C fossil fuel is used for space heating. This exercise is not only costly affair but also not environmental friendly. Moreover there is psychological barrier in the minds of the troops as they are not able to meet their basic requirements.

In Leh and Kargil lives have changed after the functioning of the Hydel Power projects of upto 45MW. Hydel Electricity is fast replacing the fossil fuel and is now available for more hours in comparison to diesel power which was for 3 hours in a day. But still border areas are forced to use the diesel generators and there is always uncertainty associated with the energy resource specially in winters.

In border areas of Ladakh geothermal sources are naturally available at Puga and Chumathang in eastern sector which has capacity to produce upto 50 MW of 24x7 electricity in extreme conditions. In western sector of Ladakh Panamic a and Sasoma are good natural resources and have been utilized by civil and army respectively. In 2012 geothermal resource explored and developed in Siachen Base by Dr Ritesh Arya definitely provided psychological advantage to our troops by proving hot water from the borewell drilled. This geothermal source can be used in war and peace by providing sustainable reliable zero emission cost effective geothermal energy and hence boost the morale of the troops besides providing socio economic upliftment to the villagers in the border areas of Ladakh by providing sustainable space heating and green house solutions based on geothermal.

#### **Pilot Projects**

There is urgent need to set up pilot project showing direct and indirect utilisation of these resources in Himalayan region so that this resource is systematically developed. Direct utilisation for constructing swimming pool and spas can be planned with tourism department in Himachal and J and K governments. Greenhouses can be build with locals or army in Ladakh region to cater to the growing vegetable needs so that both of them benefit from the geothermal resource. Moreover the socio-economic status of the villagers living in adverse climatic conditions will improve significantly once they have income generated from green houses functional in winters when roads connecting to rest of India remain closed for more than 8 months. Indirect utilisation of this resource is also planned for setting of making a building green using geothermal resources. A demonstration of pilot project in existing and

new building will be planned in Leh and Himachal so as help the users to gain insight into the practical applications of geothermal sources for heating and cooling in places which are actually away from the tectonic zones or areas where no geothermal springs have been recorded using GSHP technology. New Leh Airport terminal could be interesting place for actual demonstration

#### **Conclusions**

Presently the geothermal resources in India are not developed as a resource and its utilisation since time immemorial is restricted for bathing washing and cooking only.

Direct and indirect utilisation of geothermal resources in power generation, greenhouse and promoting geotourism will help it better utilisation of this resource for sustainable socio economic development.

Also pilot projects will be identified where indirect applications of geothermal resources in space heating and cooling will be demonstrated in old and new buildings so that the application of geothermal resources becomes a household phenomenon in Hill states. Tibetan and nomadic school at Puga would be good example for demonstration of pilot project for space heating so that the inmates in school remain comfortable in winters when temperatures drop to minus 30C.

#### **Acknowledgements**

Authors are thankful to Norway Research Council and Arya Drillers for granting necessary funds for carrying out research in Himalayan region. This project will go in a long way to promote geothermal research in Himalayan region and boost efforts to develop geothermal resources in India in systematic and scientific manner for building sustainable energy efficient habitats in the future. R. Arya is also thankful to Guardian for ranking Agneyodgara among top 10 innovators in World Future Energy Summit Abu Dhabi and Prof. Grob for letting him present agneyodgara findings in world sustainable energy conference organised by United Nations International Sustainable Energy Organisation Geneva in 2012 □