

A Review of National Agricultural and Water Resource Policies and Practices in India With Case studies on Uttarakhand and Sikkim

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Abstract: *The report aims to review the various agricultural policies currently in place in terms of focus on the yield capacities as well as the addressal of farmer livelihoods. Beginning with the study of policies from the post green revolution India, the shortcomings of subsequent policies are studied along with the National Agricultural Policy 2020, which aims to address and solve many of these issues.*

Keywords: Agriculture, water resource, policies, Sikkim, Uttarakhand

1. A Review of National Agricultural Policies

The report aims to review the various agricultural policies currently in place in terms of focus on the yield capacities as well as the addressal of farmer livelihoods. Beginning with the study of policies from the post green revolution India, the shortcomings of subsequent policies are studied along with the National Agricultural Policy 2020, which aims to address and solve many of these issues.

1.1 History

The green revolution, though making in India self sufficient in terms of foodgrains, also brought forward many other problems. The growth was limited only to the well irrigated areas (primarily, the northern states), foodgrain production which increased from 55 million tonnes in 1951 to 108 million tonnes in 1971, and to the landowning farmers who could afford the high input cost of High Yielding seeds (HYV) and farm machinery.

Added to these are the concerns related to the land and water resources which are now under severe pressure. As the focus on a high output continued, the groundwater levels either significantly decreased or it was rendered of no use due to seepage of poisonous fertilizers and pesticides while the land suffered soil erosion and overuse.

Nearly two-thirds of the area under cultivation continues to depend upon rainfall. Majority of the land is cultivated by small farmers, practising subsistence level agriculture. This has limited the benefits of the green revolution to a few.

1.2 Present Scenario

National Agricultural Policy, 2000 aimed at tackling many of these challenges. One of the most important issue addressed in the NAP was the need for a sustainable form of agriculture. Aiming to “promote technically sound, economically viable, environmentally non – degrading and socially acceptable use of country’s natural resources – land, water and genetic endowments.”

1.2.1 Land Use: NAP proposed to bring wastelands under agriculture and afforestation but failed to provide any plan to do so. Also, huge investments are needed in order to convert

fallow lands into cultivable ones. The problem of degradation of cultivable land due to non-judicious use of fertilizers was not addressed.

1.2.2 Irrigation: NAP emphasizes use of watershed approach to manage land resources. Watershed approach is also proposed for rainfed agriculture. Even though addressing the need for “rational utilization and conservation of the country’s abundant water resources will be promoted”, the policy did not provide any concrete measures for the implementation of the same.

1.2.3 Plant and Animal Genetic Resources: NAP expresses concern about the narrowing and erosion of India’s plant and genetic resources in the last few decades. Here, again it does not acknowledge quality improvement by using indigenous varieties but rather tends to focus on the expensive foreign ones which have come up with problems of their own when it comes to adapting to the Indian climate.

1.2.4 Employability in agriculture: The policy identifies agriculture to be a relatively unrewarding profession, causing abandoning of farming and increasing migration. With growing population, agriculture has experienced a growth in the number of agricultural labors with no significant rise in the production, hence, leading to unproductive work and low wages. It talks about alternative off-farm employment of the farmers as a means of providing a steady income but does not provide any concrete ideas.

1.2.5 Economic aspects: It aimed at achieving a growth rate of 4% in agriculture but, failed to do so. Infact, in the 12th five year plan (2012-17), again a growth rate of 4% was echoed as a target, signalling the inability to achieve so in over a span of 12 years. As of the fiscal year 2014-15, the growth rate of agriculture was a meagre 1.1%. The low growth rate in 2014-15 has been pinned upon the countrywide drought and meagre monsoon. This goes on to emphasize the economic risk that rainfed areas continue to face, thereby depriving them of any increase in productivity which might have happened due to the widespread availability and subsidies for superior quality seeds, fertilizers and farm inputs as at the end, the availability of water for crops is equally, if not more important for high productivity.

NAP aimed at increasing investment in agriculture but investments as well as capital formation have steadily declined. To tackle the issue of production risk, National Agricultural Insurance Scheme (NAIS) was put into action. It provided 10% subsidy on premium to small & marginal farmers. But, according to An Evaluation of National Agricultural Insurance Scheme in India by Poonam Patwardhan, Vinayak Bhise and Sunil Narwade, "Farmers expect to receive alternative payment from the government in catastrophic year/crop failure years irrespective of premium payments but the delay in claim payments is one of the reasons for farmer's unwillingness for participation in the scheme." Hence, it left room for an improved insurance policy with better risk management to address the now increased problem of farmer suicides.

Effective from 2015-16, the government introduced a Modified NAIS or MNAIS to provide insurance cover to the farmers in the event of failure of crop or low yield. It also identifies "High Risk Crops" which may be more prone to climate changes and has increased premium on such crops. Calamities such as "landslides and hailstorms" have been addressed but many states want the policy to include regional calamities as well. The policy is still in its early stage and its effects are yet to be studied.

1.2.6 Research and Development: The development of High Yield Variety (HYV) seeds of cereals was the primary driver of green revolution in the country. Subsequently, many State Agricultural Universities (SAUs) were set up to continue research and education in this area and also to conduct area-specific research. Indian Council of Agricultural Research (ICAR) continues to be the apex institution, allocating funds for research and running various country-wide programmes such as National Agricultural Technology Project (with funding from the World Bank). State governments set up various institutes for Zonal research related to the specific climatic conditions or agricultural commodities characteristic of that area.

The share of research expenditure in total outlays for agriculture decreased drastically from 7.2% in the IV Plan to 2.6% in the VII Plan has only increased a little since then. The entry of the private sector is relatively new in agriculture and is unlikely to make up for the huge gap created by reduced government funding in the near future. Besides, agricultural research is not limited to the development of good quality, disease resistant crop breeds. It also involves innovation in farm implements, development of new irrigation methods and management of natural resources for sustainable agriculture.

In the recent years, under NATP, research for rainfed agro-ecosystems has been a major focus. This has led to development of moisture conservation technologies for drier regions and successful implementation of agro-horticulture in such regions. Also, in coastal cyclone-prone areas, various new varieties of rices have been developed. Implements such as disease detection kits for plants and a mussel seeding machine has been developed while experiments with various varieties of oilseeds have resulted in improved livelihoods for farmers in the arid regions.

Even so, there are several studies analyzing trends in sectoral allocation of ICAR resources. Jha et al. (1995) observed undue high allocation of resources to extension at the cost of education and research, and also that allocations to horticultural and livestock research were not commensurate with their economic significance and expected contribution to equity, sustainability, and exports. Suggestions have been made to allocate more resources to specific states who are in more need such as north-eastern states. Allocation of research resources used to be largely based on historical a trend which now needs to be changed to a more goal oriented approach with regional farm and weather constraints.

1.2.7 Farmer Education: At the centre of all the new technologies developed and policies being framed for agriculture is the Indian farmer. Hence, for the fruition of these plans and ideas, the awareness and education of farmers is of utmost importance. SAUs run many such programmes which involve training farmers and introducing them to new technology and creating awareness about various credit and insurance policies. Various Agricultural Technology Information Centres have been set up to provide soil and plant diagnostics to farmers. Zonal Agricultural Centres or Krishi Vigyan Kendras deal with organising training programmes and demonstration for the farmers. They are also responsible for over 422 radio programmes aired in various vernaculars. While this looks very encouraging, a state bias creeps in with many states faring better in terms of communication with the farmers. Various factors affect this, such as location and terrain, general literacy rate in a state and at times, the state government itself.

1.3 Vision for the Future

At the end, the paper titled "Vision 2020" recently brought forward by IARI, finally takes the lead in addressing various economic, productivity and sustainability concerns related to agriculture. It addresses that industrial sector has surged ahead at a very high rate, reducing agriculture's share in the national income. It calls to create policies in order to tackle the growing demand for food due to a population explosion while taking a route towards sustainable agriculture that addresses the issues such as degradation of resources, impact of globalization on small farmers, use of modern biotechnology to increase productivity and to deal with rapidly increasing poverty among the farmers. It calls for a much needed and perhaps, a welcome move in calling for an "institutional change" for better communication between the academic and the farming communities in order for technological advancement, credit management and risk assessment.

1.3.1 Enhancement of Yield: It calls for refinement and better transfer of technology to tackle technological gaps, along with region specific soil and water research. The need of balanced nutrients in fertilizers is also stressed upon. Target states have been chosen to bridge the yield gaps, for example, Bihar, Orissa, Assam, West Bengal and Uttar Pradesh are the priority states accounting for 66% of rice area which need emphasis on bridging yield gaps to attain target demand and yield growth.

1.3.2 Water resource management: With the ever increasing groundwater levels and its deterioration, it calls for the formulation of water use policy and that a national institution may be established for the purpose of regulation and means to create awareness and transfer technology for conservation of water resources. It addresses the plight of farmers in rainfed regions and suggests better distribution and research in dryland irrigation technologies

1.3.3 Investment in Agriculture: Public investment in agriculture should focus on timely availability of inputs, efficient and environment friendly post harvest technologies, research in productivity increasing crop and livestock varieties and improved institutional and credit support by empowering rural infrastructure.

This needs community level support. The paper calls for a community based approach to promote management of resources and to improve food security. Government also would need to enhance healthcare and educational facilities to the rural poor.

Moreover, mobilization of technology through national and international partnerships and the farmer community is needed.

1.3.4 Combating poverty and hunger: The paper cites a research which suggests that even a small increase in the land helps reduce poverty among the small farmers. It states that extensive irrigation would not only help reduce poverty in the rainfed regions but also reduce environmental degradation. As livestock has the highest rate in reducing poverty, hence, livestock sector should receive a high priority. To reduce poverty among the small farmers, alternative employment is a good approach. A call to empower the Panchayati Raj in order to implement agrarian reforms and locally manage the water resource is made. Giving them administrative power as per the 73rd and 74th amendment can help address many plights of a small farmer.

1.3.5 Disaster Management: As we face the effects of climate change, an increased number of natural disasters such as droughts, floods and cyclones have hit the country. Better communication systems and mobilization in times of need are needed in place to minimize the damage to the agricultural sector.

1.3.6 Technological Advances: The great potential of Biotechnology as a means for advancements in agriculture has been acknowledged by it in terms of developing new varieties of crops and livestock or by innovation in the field of agribusinesses and agricultural products. Also, efforts must be made to strengthen informatics in order for better forecasts. Also, GIS and remote sensing technologies must be widely used for assessing natural resources. An integration with e-businesses for better market opportunities should also be encouraged.

2. A Review on National Water Policies

2.1 History

The first National Water Policy was enunciated in 1987. Since then, it has been revised in the year 2002, followed by in 2012. While the first policy focused on providing water for drinking/domestic purposes and irrigation, in 2002, environmental concerns were addressed.

In 1987 and 2002, a set priority list for water allocation was established within the policy. However, it was done away with in 2012. The policy in 2002 drew criticism from the experts for its lack of providing solutions to social injustices related to distribution of water and to mention the need for development and popularization various water saving technologies. (Effectiveness of National Water Policy 2002 for Development: A Summary Prof. Sanjeev Ghotge Centre for Applied Systems Analysis in Development, Pune)

In a report submitted for the purpose of 12th planning commission by a team of experts from the council on Energy, Environment and water, it was pointed out that a lot of water which is used for irrigation ends up as waste due to injudicious practices. It said that on the farm level, various users associations have failed to educate and regulate about irrigation methods and in turn, farmers use flood irrigation methods instead of more efficient practices. It addressed the failure of water supply management to households across the country and the problem of unauthorized extraction of water. Another issue that needed to be addressed was the release of industrial effluents into the water bodies, thus causing enormous damage to water resources.

Also, when it comes to management of water resources, the sole responsibility of it lie with the Irrigation Department which is mainly concerned with the usage of water in agriculture only. The report suggested to create a separate department within the ID, called Water Resources Department.

In, it has been pointed out that the 2002 water policy lacked inter-sectoral linkages, fails to identify various communities that are deprived of water and promotes large scale, expensive projects such as dams instead of promotion of cheaper and more affordable technologies.

2.2 Present Scenario

Subsequently, a new National Water Policy was framed in 2012. By this year, climate change had started to show its effects very noticeably. This policy, unlike its predecessors, did away with a hierarchical priority for water use. Below are some of its important policies:

2.2.1 Efficient Usage of Water:

- It has been assessed that over 80% of the water is used in irrigation. There is a great scope for using technologies such as micro-irrigation, sprinklers, aligning of cropping patterns etc in order to reduce water consumption.
- Use of small local level irrigation through bunds, field ponds, agricultural and engineering technologies for watershed development

- Water auditing to be carried out for various industries and environmental impact assessment for industries to include water footprint as a benchmark.

2.2.2 Water Resource Management

- The policy looks at water as a national resource
- Promotes direct use of rainfall, desalination processes
- In order to tackle the problem of the ever depleting groundwater, watershed management using technologies such as aquifer mapping. It also calls for community based efforts and incentivizing water efficient methods
- It promotes inter-basin transfers for more equity”.
- Programmes such as MNREGA may be used by farmers to harvest rainwater by methods such as ponds and other soil and water conservation method

2.2.3 Water Supply and Sanitation

- Addresses the need to supply clean drinking water and water for other domestic needs for all
- Calls for publishing of water audit reports indicating leakages by urban domestic water systems
- Integration of urban water supply with the sewage system and including charges for sewage treatment in the water bills
- Mandatory for industries to return the water used by treating the effluents
- Provision for subsidies and incentives for treatment of industrial effluents

2.2.4 Conservation of water resources

- Calls for conservation of rivers, river corridors via “scientifically planned community participation” while taking into consideration the natural ecosystem of the area
- Any developmental projects or settlements in the upstream area of reservoirs should be restricted
- Third party inspection should be carried out periodically to control pollution of water bodies
- As groundwater is more difficult to purify after it has been polluted, it is imperative to ensure that industrial effluents, residues of fertilizers and pesticides do not reach the groundwater
- Setting aside a percentage of funds for maintenance of existing water structures like dams and embankments

2.2.5 Adaptation to Climate Change

- Focus on mitigation at micro level by “enhancing capability of the community”
- To tackle variability in availability of water, focus on water storage in various forms and to incentivize states for adopting water storage methods
- Focus on making agricultural and industrial processes more water efficient
- Stakeholder participation in land-soil-water management with scientific inputs from local research and academic institutions for evolving different agricultural strategies, reducing soil erosion and improving soil fertility should be promoted.

2.2.6 Planning and Implementation

- The integrated water resources management with emphasis on finding reasonable and acceptable solutions for most of the stakeholders should be followed for planning and management of water resources projects.

- Local governing bodies should be involved in planning a project
- All hydro projects should be planned as multi-purpose projects in order to draw the maximum benefit

2.2.7 Institutional Framework

- Proposal to set up a Water Disputes Tribunal at the Centre
- Integrated Water Resources Management (IWRM) taking river basin / sub-basin as a unit should be the main principle for planning, development and management of water resources

Over the years, the policy has come under criticism for various reasons. In a press release article, while welcoming the approach of micro mitigation in adaptations to climate change, he points out that the policy does not lay out any methods to improve upon the existing water infrastructure for making it more resilient to climate change. Also, agricultural practices to increase soil’s water retaining capacity such as increasing carbon content in soil, organic farming etc, do not find a mention in the adaptation to climate change. The policy underestimates the role of these biological, low investment approaches in a trade off to promote investment heavy projects like dams and embankments.

They point out that the key to sustainable management of water resources lies in community based efforts which support small scale improvements around the local area. Such decentralization of decision making would enable the local communities to decide on their own resources as they are the ones who suffer the most, as is evident from the case of various dams which lead to the displacement of the local population who many a times do not even benefit from it. The policy has also failed the growing problem of groundwater depletion. Over 80% of the water needs of the country are met by the groundwater. The natural reserves of groundwater have come under severe stress due to overuse in many states, especially the northern states. Though many states have formed policies for dealing with this matter, the national policy has not provided any solid method to tackle it.

Water yet remains a resource in control of individual states. The policies framed by the states have a far more effect on the management of water resources while the National Water Policy serves as a policy guideline. Being more aware of the issues surrounding them, state governments have devised their own methods to deal with water issues unique to them, as such a comprehensive approach is difficult to implement in a National Water Policy.

3. Case Study 1: Uttarakhand

Carved out of Uttar Pradesh in the year 2000, Uttarakhand is a primarily hilly state with few districts in the plains. Although about 70% of its population is employed in the primary sector, low agricultural output, migration from the hills, farmer poverty and repeated natural disasters such as floods, remain a hanging problem to deal with. Being nestled in the delicate ecosystem of the Himalayas, the dramatic effects of climate change have begun to affect people.

- **Geographical Disparities:** A 2007 study states that the growth in the state from the beginning has not been equitable. Due to geographical advantages, the plains have fared better than the hills, where the growth rate has been slow to increase. Due to being cut off from the rest of the state, the hills have also been bereft of roads, electricity and irrigation—all of which are used as input in modern farming practices. The Green Revolution and the subsequent technological advancements were confined to the plains. Since, industrial development was also constrained due to the hilly terrain; agriculture in the hills remained the primary source of income, however meagre that might be.
- **Fragmented farmlands:** Uttarakhand's, average land holding trends are similar to the national average. But the overall landholding average is lower than the national average because almost 70 per cent of the land holdings in Uttarakhand are marginal and 18 per cent are small. As a result, most farmers in the hills practice subsistence level agriculture due to their poor economic status and do not use expensive inputs. Over 60% of the hills are covered by protected forests, hence it is difficult to bring new land under cultivation. Subsistence farming does little to provide stable livelihood as not much surplus for the market is available.
- **Migration:** As agriculture failed to provide for livelihood and other employment opportunities in the hills remained limited, male migration in search of employment opportunities to the towns and cities has become increasingly prevalent. This has led to a lack of available workforce in the already sparsely populated and labour intensive hills. Women have taken to fields. Hence, it has become imperative to formulate women-centric policies related to agriculture.
- **Lack of Connectivity:** Due to lack of well-maintained roads, it becomes difficult to take the farm produce to the city markets. With the exception of district of Almora, there are no organized agricultural markets in other hill districts. As cluster approach in farming gains popularity, it has become imperative to develop networks connecting farms to the markets, especially in case of perishable produce.
- **Irrigation and drinking water:** Of the total irrigated area in Uttarakhand, only 12% lies in the hills with about 88% in the plains. Many cultivated areas in the hills are situated above the rivers, making it impossible to use gravity-driven methods such as canals to provide irrigation. The dependence on rain for agriculture has led to unreliable output.
- **Modern farming implements:** Factors such as uneven terrain, subsistence farming, poor irrigation facilities and lack of electrification contribute to low use farm machinery.
- **Soil Erosion and water depletion:** In the recent years, the increased flooding and the magnitude of loss of human life as well as economic setback due to it have emphasized the need for a more careful development of hills while bringing into consideration the fragile ecosystem of the Himalayas. Floods and landslides have become increasingly common, leading to soil erosion and loss of lives and livelihoods. Moreover, the loss of forest cover has led to increased soil erosion, making the already thin

layered mountain soil to grow thinner. It has also reduced the water storage capacity of the hills and led to a water shortage in the natural springs. This drop in ground water combined with already poor irrigation facilities has affected both agriculture and drinking water availability.

3.1 Agricultural Policies and Practices

3.1.1 Need for diversification: When it comes to subsistence, rainfed farming, diversification of agriculture provides the most suitable solutions. With a varied climate suitable for a plethora of crops, horticulture, floriculture, medicinal and aromatic plants play a big role in tackling low farmer incomes. Some other initiatives include:

- **Mushroom Farming:** Suitable weather conditions have led to a steady market for Uttarakhand mushrooms in the country, in turn spurring mushroom growers to experiment with varieties that suit every palate. While in the plains they need to be grown under controlled climatic conditions, the low temperature of the hills provides for suitable natural conditions. The Department of Horticulture provides subsidies to farmers who want to set up their own mushroom farms. The government has preferred the cluster approach in order to integrate fragmented lands in particular area. With the help from universities, mushroom training has become popular. In the year 2014-15, over 10,000 tonnes of mushrooms were produced with about 7,000 of them being produced in the Garhwal region.
- **Hemp farming:** In 2015, Uttarakhand became the first state to legalise the cultivation of cannabis. Only hemp with tetra hydro cannabinol (THC) content of 0.3 to 1.5 percent can be cultivated for industrial purposes like in the manufacturing of fibre. Only licensed farmers would be able to trade in this and the produce would be directly sold to the government with no room for private buyers. A Hemp is a low maintenance crop that requires little care and investment in terms of resources. It can easily be grown even in places with lesser rainfall. Furthermore, goods made from hemp fibres would also contribute to the cottage industry. The government has also tasked research institutions such as CSIR to develop newer varieties of hemp for commercial use. The Nanda Devi Handloom and Heritage Centre of Excellence, inaugurated in November 2015, employs women for every task—from growing hemp, its processing and for making products out of hemp ropes, providing them with a stable source of income.
- **Aromatic and medicinal plants:** They have helped farmers generate revenue of Rs. 35.38 lakhs in 2006-07 and created employment of around 1910. These benefits have been generated with the help of the Herbal Research and Institute (HRDI) that works on aromatic plants used in cosmetics, soaps, and perfumes. The HRDI has identified areas in selected hill regions where these crops can be grown and adopted a clustered approach that includes production and processing. But the high cost of post-harvest processing has prevented the widespread adoption of these.

3.1.2 Organic Farming: Uttarakhand is the first state to be declared an organic state. In Uttarakhand around 10,000 ha land is under organic farming, covering over 15,000 farmers and 45 crops. The key objective of diversifying towards

organic farming is to improve crop productivity, soil health and the price of the output, and thus the income of the farmers. As a means to promote organic farming in the state, Uttarakhand Organic Commodity Board (UOCB) came into existence. The UOCB has an export market for basmati rice and spices, such as chillies, coriander, and amaranth. Training in organic food processing and value addition have been imparted to the producer groups, but lack of infrastructural facilities is a major constraint. The concept of “branding” organic commodities has also emerged as a means of selling them on a global scale. Retail outlets such as “SARV, Handicraft Emporium” in Dehradun have been set up. As the price of all organic commodities is comparatively higher, the farmers who have switched to it reported higher incomes.

The meagre availability of chemical fertilizers due to lack of connectivity has fuelled the growth of organic farming. In an initiative by the Centre of Organic Farming (COF), 00 bio-villages are directly linked with one another so that there is scope for exponential expansion of the linkages without actually increasing the number of members in the chain. More organic producer groups / federations are being directly linked with the retail outlets for the supply of value-added products. Marketing of organic vegetables from three clusters of bio-villages in the Ramgarh belt, Bhagwanpur, Doiwala and Chamba have been initiated. Most of these villages have been successfully linked to the markets and have provided reasonable premiums to the farmers. A regular market for the sale of organic produce is linked with the 35 outlets of ‘Kendriya Bhandar’ in Delhi.

3.1.3 Promotion of Agricultural by-products: As a continuation of popular traditional practices, many small scale industries promoting products such as jams, pickles, cosmetics etc have come up. These work by employing farmers for cultivation and then, production of the required by products with the help of the village folk. The retail outlets are set up not only in towns but also in tourist spots in the hills to attract tourists as customers. Many of them also provide the food products to hotels and restaurants in the hills. Such enterprises mostly work on Cooperative approach, funded either by a trust or sometimes, by individual entrepreneurs.

3.1.4 Credit Risk Management: SBI and NABARD are the banks tasked with providing loans to the agricultural community in the hills. SBI has adopted several different methods to achieve financial inclusion. It opens a zero balance account, provides a general purpose credit card, and a kisan card to hill people; a loan of Rs. 25,000 is provided to hill people without asking for collateral. However, the presence of banks remains sparse in the hill districts.

Self-help groups (SHGs) and micro-finance institutions are the main motivators and providers micro-credit to people in the villages of the hill districts. The Reserve Bank of India (RBI) has suggested measures to improve banking services in Uttarakhand. They recommend that the help of local agricultural universities, agribusiness centers, and Krishi Vigyan Kendras may be taken to improve the quality of input and output. Banks should also be made a party to negotiations with producers to settle the credit issue on the

spot. These may act as single window clearances or tie-ups. Banks may also extend such facilities to the entrepreneurs, at least in their specialized SME branches.

3.1.5 Farmer Literacy: With a literacy rate of over 71%, literacy in general is higher in Uttarakhand than the national average. But most of the educated youth, tends to look for employment outside the hills. Many NGOs have hence, taken to imparting skills and training, particularly to the women in the hills. In the farming community, these skills might be related to adoption of new agricultural practices such as organic farming, or skills related to homemade products such as jams, pickles or even skills pertaining to cottage industries. Many government universities also provide certifications after completion of such trainings. Moreover, literacy would also involve creating awareness related to laws and rights. One such program is called Rural Litigation and Entitlement Kendra (RLEK). Apart from creating awareness among women about their rights, it also runs vocational courses that women can take and also supports the establishment of various SHGs.

3.2 Water Resources Policies and Practices

3.2.1 Irrigation: Since agriculture is the main source of livelihood, irrigation infrastructure is one of the prime requirements for Uttarakhand. Only 44 per cent of the cropped area is irrigated by the present irrigation system of which about 81 per cent is in the plains. In order to irrigate the higher lands, lift irrigation systems are being used. Hydrams, which do not use any external energy or power such as diesel or petrol, work on the principle of the water hammer and convert the available static head to kinetic energy. Water can be carried to a height of 30 times above the available head. The lift irrigation technique can act as an important tool to improve the status of irrigation in Uttarakhand, in particular the hill districts. The advantage is that the land below the supply channel (guhls) can be irrigated directly from the supply channel; in addition, by increasing the scale of the supply channel, water mills for grinding wheat and other cereals can be driven.

A traditional but effective canal irrigation system (guhls) is used to irrigate the fields using gravitational force which brings water from a distance of many kilometers. Another traditional irrigation method which is prominent in Uttarakhand is water mills. The water mills, known as gharats in Uttarakhand, have traditionally been used for milling grain and extracting oil. The estimated number of water mills varies from 3,500 to 70,000. These water mills, with little technological upgradation, can also be employed for hydropower generation. NGOs like HESCO have been instrumental in successfully implementing several micro-hydropower projects in the state. The grains milled by these micro-hydro plants, gharats, are being sold in the market under the brand name Gharat.

3.2.2 Drinking Water: The drying up of natural springs, a source of naturally occurring clean water, has added to the woes of village women as they are forced to travel long distances in order to fetch water. Groundwater has been a limited resource on the higher altitudes, though, many plain districts situated on the foothills such as Udham Singh

Nagar maintain a good ground water level. In the hills itself, while Rudraprayag has been able to provide 100% of its population with the drinking water supply, the percentage stands at just 75 in case of Champawat.

The Uttarakhand Jal Sansthan is working to provide clean drinking water from below the surface of rivers through the Riverbank Filtration (RBF) technique in the state. The innovative technique is expected to provide a permanent solution to ensure pure drinking water from rivers. The RBF technique is a collaborative effort of the Uttarakhand Jal Sansthan, Indian Institute of Technology, Roorkee, University of Applied Sciences, Dresden, Germany, and Dusseldorf Water Company, Germany. Instead of using surface water, the RBF technique relies on channelling the water below the surface. Though, in the long term, watershed management and rainwater harvesting programmes can help in the replenishment of the ground water, along with afforestation.

4. Case Study 2: Sikkim

The tiny mountainous state of the north east has been known for substantial water resources and small, fragmented farmlands. Out of the total geographical area of 7,29,900 hectares only 10.2% is cultivated with a other land being utilized for forest cover, pasturelands, barren and uncultivable land and land put to non-agricultural use. Unlike Uttarakhand, the total farming area is much less, primarily due to limited plain areas. Along with the growth of cereals, pulses such as urad, soyabean and mustard are also prevalent. Many of the issues faced by agriculture and water resources in Sikkim are similar to Uttarakhand due to their similarities in terms of the geography. Below, the policies and practices are discussed in reference to Sikkim.

4.1 Agricultural Policies and Practices

4.1.1 Diversification of Agriculture: Though, traditionally a state dependent on agro-forestry and a semi-pastoral society, agriculture as we know today, was a late development in Sikkim. As open fields for foodgrains is limited, the agriculture in Sikkim has diversified into horticulture and farming of spices and medicinal plants, making Sikkim a major supplier of cardamom, ginger and turmeric. Tea grown on the rainfed slopes of the hills is not very popular, but a promising business. The state is home to 450 varieties of orchids and recently, the government has been making efforts to promote floriculture as well. Though the bleak terrains of the north and northwest are not very suitable for agriculture, crops such as maize are grown in South Sikkim, where the climate is warm.

4.1.2 Organic Farming : In 2003, the Sikkim government proposed to adopt organic farming and by the end of 2015, most of the farmlands in Sikkim have been converted to organic farms. Though, eight states have adopted organic farming as an alternative, Sikkim is the only state to have framed a separate policy for organic farming. In order to make farming sustainable and more suitable for the delicate ecosystem and to maintain soil health of, organic farming was adopted. The action plan involved production of organic manure, use of microbes in increasing soil fertility, green

manuring and cultivation pulses for nitrogen fixation and promotion of biodynamic farming. The charter also called for adoption of traditional practices for sustainable agriculture such as “Rishi Krishi”, in which the Rhizospheric soils from beneath the banyan tree are spread and a bio inoculant containing cow dung, cow ghee and honey is regularly used via irrigation channels.

The policy strategies addressed the need to impart appropriate training, including local SHGs and NGOs, marketing of organic products and policies to completely eradicate the usage of chemical fertilizers and pesticides. In 2011, Sikkim the led way to persuade the Central government to subsidize organic fertilizers as well, along with the long standing subsidy on chemical fertilizers. Adopting a cluster approach, post harvest processing plants were set up, especially for high valued crops such as ginger and turmeric. Regarding the enhancement of infrastructure, the policy dealt with providing soil testing facilities, strengthening of Integrated Pest Management Laboratory, establishment of biofertilizers of local strains and strengthening of research facilities. The state has also refrained from using GMO seeds for any crop so far. The policy specifically called for local production of seeds as far as possible. It also called for accommodating animal husbandry with agriculture as it would be beneficial both economically and organically, providing a source for organic manure.

While the exportable commodity growing areas were kept under the third party certification, but organic certification for non-exportable commodities was made cheaper and sustainable using PGS (Participatory Guarantee System). It included setting up zonal and regional councils authorized by the National Centre of Organic Farming with officers trained in the methods of organic farming. The policy aimed at promoting research and subsequently, the use of modern, sustainable methods of Organic farming, in collaboration with research institutions and agricultural universities.

4.2 Water Resource Policies and Practices

4.2.1 Groundwater and natural spring replenishment: Sikkim has a very steep gradient. Beginning at an altitude of a mere 300 metres at the southernmost tip, the other end of the state rises to as high as 8550 metres. Even though Sikkim is a region receiving a heavy yearly rainfall, this steep slope prevents the water to stand long enough for percolation into the ground. The water streams downwards quickly, only resting when an open area is encountered. In the monsoon, many streams and lakes are present in Sikkim, which all dry out during the rest of the year. This problem is more severe for the regions in the north and northwest as even the groundwater is limited. With deforestation, this problem had only escalated leading to soil erosion and at times, frequent landslides.

To tackle these issues, “Dhara Vikas” programme was launched in 2008 under MNREGA. Using scientific methods with the help of academic and research institutions recharge areas of the springs and streams were identified. The pilot phase involved digging trenches and laying out pipes to carry rainwater to the springs for Nagi Lake in South

Sikkim. After its success, the programme has continued and over 50 springs have been revived. The project also involved creating a village spring atlas web portal providing information about 700 springs. According to a 2013 report by IISc, Bangalore, this programme has been beneficial in increasing the production of fruits and vegetables, estimated to be a 25% increase.

4.2.1 Conservation of glacial lakes: Northern corners of the state are home to many glacial lakes, several of which in turn are the sources of water for rivers and streams. Due to global warming, the glaciers have been receding faster than ever before. High altitude lakes along with their catchment area and the flora and fauna around them are considered to be Protected forested areas by law. Though many of these lakes were inaccessible before and the catchment area was used only by yak herders. Since the growth of road tourism, these lakes have become tourist spots in many cases. 11 of these lakes are of religious importance and pilgrims flock to these ever season. Waste management, providing sanitation facilities, parking of vehicles and mushrooming of shops were the main issues faced in such places. In 2006, a framework for lake conservation was designed.

These guidelines decentralize the management of the lakes to the local community. It also included the scientific component of baseline survey and annual conservation planning. Termly assessment of the quality of water, quantification of threats such as effluent pollution and waste were also included. In spite of National forest and wildlife laws, the Himalayan lake continue to be plagued by overgrazing, mismanagement of tourism and poor monitoring. High altitude lakes, if monitored frequently can warn against potential floods.

Tsomgo Pokhri Sanrakshan Samiti (TPSS) is the first lake conservation committee formed in Sikkim after the announcement of the new framework. TPSS is given the power to be the local custodian of Tsomgo Lake and entrusted with the collection of a conservation fee from each tourist visiting Tsomgo. Fifty per cent of the collected conservation fee is deposited with the State Environment Agency. The money is again given back for conservation of the lake and other threatened wetlands that need immediate attention. The remaining 50 per cent of the collected fees is used for various conservation activities budgeted under the Annual Lake Conservation Plan. So far, TPSS has collected around INR 8.2 million from tourists visiting Tsomgo Lake. One of the biggest achievements for the conservation of the lake was relocating the shops by the state government from above the lake side to a shopping complex. The other successful intervention where the continuous efforts of TPSS made a difference is the management of garbage. TPSS members regularly conduct awareness generation programmes with the Tsomgo community, and all important days for conservation like World Environment Day, World Water Day are observed.

4.2.3 Climate Change and Disaster Management: Prone to cloud bursts, flash floods, landslides, windstorms- these problems have only escalated with the change in the climatic pattern. The rainfall pattern has shifted and increased population leads to an increase in deaths due to these

disasters. In this regard and from the historical experience, Sikkim is moving forward to draft a Road-map for Sikkim State Action Plan on Climate Change for building better climate resilience and the Disaster Risk Reduction agenda in Developmental Planning. Department of Science and Technology (Sikkim), Land Revenue and Disaster Management Department (Sikkim), Sikkim State Disaster Management Authority (SDMA), various NGOs and different national and international institute and organizations are coming forward in a collaborative manner to integrate the knowledge system for implementing Sikkim SAPCC 2016-2020.

The nodal department has already started an adaptive strategy for harvesting rainwater, enhancing water storage capacities, enlarging water security in vulnerable blocks of Sikkim, introducing a new varieties of seeds, linking protected areas for animal movement, promotion of ecotourism, solid waste management for the urban areas, developing model Gram Panchayat Unit (GPU) with relevant team, mapping landslide hazards prone areas, 24x7 manned control rooms set up at both State and district level, introducing a singular number to call during any disaster events, establishing landslide prediction instrument, developing Early warning System for landslide hazards, organising different disaster risk reduction measures including climate change workshops and seminars, and most importantly, Sikkim is proposing the establishment of "Himalayan Institute of Disaster Management and Climate Change" to represent the entire Himalayan region.

5. Conclusions and Recommendations

Though National Agricultural Policies have served as a guideline for the policies to be formed by country and the states, it has failed to address many region specific concerns. States such as Sikkim, where organic farming has become the norm, have planned way ahead in terms of a sustainable agriculture. Several years after the Green Revolution, there still remains a huge gap in the transfer of technology to the farmers. The strengthening of Krishi Vikas Kendras, decentralization of the decision making process and framing of region specific policies is the key to a sustainable and also, economically profitable agriculture.

Similarly, water resource management needs to be more about a community effort, aided by technical and administrative expertise of the scientists and officials and less about framing of policies that are ignorant to the needs of the local community.

The fact that states with sensitive ecosystems have taken to framing their own policies, points out that for very long the national policies on agriculture and water resources have refrained from framing region specific policies. This has had major consequences as these are also the states which have suffered the most economically in terms of climate change.

In agriculture, there has been a clear shift from yield focused policies to the policies that are profitable to the farming community. With the help from research and educational institutions, region specific research in agriculture has increased.

As sustainability takes the centre stage, integration of traditional farming practices into the modern approach has seen a growth. These practices hold the credibility of sustaining the natural ecosystem for centuries. Also, local farmers tend to be familiar with these much more than the modern methods.

In both Uttarakhand and Sikkim, small scale, inexpensive projects related to water resource management have been implemented. Such projects are easier to implement and are inclusive. Their success depends on combined community efforts rather than a large sum of funding. Hence, more small scale approaches should be introduced, in the sectors such as water resource management where community efforts can be utilized for their own benefit. Also, interlinking of policies can be very helpful. For example, Sikkim's "Dhara Vikas" programme has been implemented in conjunction with MNREGA. Such programmes benefit from a community effort and a combined pool of funding.

In culmination, new policies regarding agriculture and water resources management would need to be more inclusive of local communities in both decisions making as well as the implementation process. Such an approach in decision making would serve the local, at times the delicate ecological systems while in the implementation phase, it would lead to economic benefits and would therefore, truly contribute to a achieving a long term, sustainable model in which ecology and economics are interlinked in the interest of the community.

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