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FEWLing the Growth

Food, Energy and Water nexus for Livelihood Security in India

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FOREWORD

FEWLing the Growth: ***Food Energy and Water nexus for Livelihood Security in India***

Food Energy and Water nexus for Livelihood Security in India form the three quintessential resources that are critical to fuel economic growth and ensure livelihoods, underpinning achievement of 75% of the Sustainable Development Goals (SDGs). These three hold the key to an equitable and sustainable future, especially for India, which have the potential to be the second largest economy by 2050 with a GDP of USD 42 trillion in Purchasing Power Parity. By 2050, with a population of 1.7 billion people, India would require 30% increase in food production and face 32% increase in water demand from 2017 levels. Further, more than 880 GW of new power generation capacity would be needed by 2040. The challenge of Food, Energy and Water security in India is, thus, going to be a decisive factor in India's development story.

Food, Energy and Water have an intricate network of inter-linkages and interdependencies running across the economy. This results in transcendence of vulnerabilities in one resource to the other two. Such complex and dynamic interactions among the three resources, coupled with the increasing demand and constrained supply, exacerbated by climate change, necessitates a paradigm shift from the conventional fragmented approach to a nexus approach in managing these resources.

The report titled "**FEWLing the Growth**: ***Food Energy and Water nexus for Livelihood Security in India***", highlights the positive policy signals and actions on ground by private sector towards an integrative approach on managing FEW resources. The report provides national and global best practices on leveraging the nexus, centered on overall resource efficiency and livelihood generation. These case studies hold huge potential for replicating and scaling the nexus approach in current policy and business landscape to create maximum impact.

The report outlines a strategy-risk-return model for mainstreaming the nexus approach, with strategies targeted at effective mitigation of vulnerabilities and risks to livelihood through an integrative approach, while leveraging innovative technological and financial solutions for optimum returns. The report charts an implementation roadmap with four critical elements for FEWLing the growth of nexus approach -Framing enabling 'nexus-sensitive' policies, Establishing innovative business models and financing mechanisms, Weighing the trade-offs and exploring synergies between the sectors and Leveraging the power of partnerships to achieve FEWL security.

I am confident that this report will provide important insights for policy makers, industry, communities and all relevant stakeholders in integrating Food-Energy-Water nexus approach throughout the economy, with an objective of ensuring livelihood security and identifying mutually synergic responses to India's developmental challenges.

Thank You.

Sincerely,

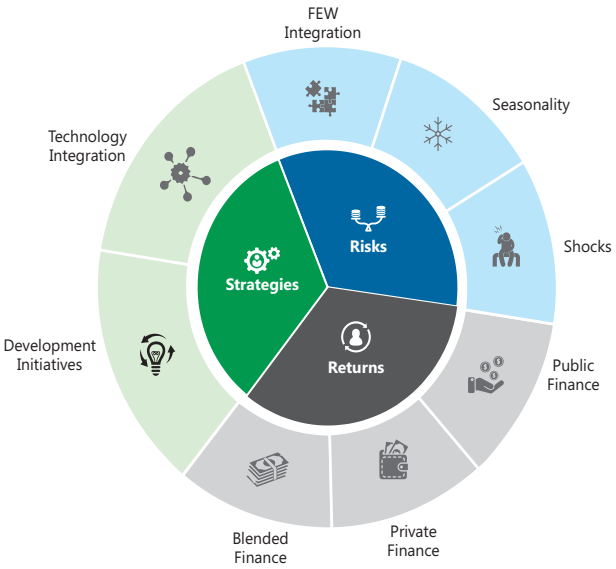
Rana Kapoor
Managing Director & CEO YES BANK
Chairman YES Global Institute

EXECUTIVE SUMMARY

In the backdrop of the birth of the 7 billionth human, the former United Nations Secretary General Ban Ki-moon gave a historic address at the 66th General Assembly, which emphasized the need for connecting the dots between climate change, water scarcity, energy shortages, and food security. This appeal for providing a holistic solution for the Food, Energy and Water (FEW) security challenges is especially relevant for India today. The country's ambitious economic and policy targets, including the predicted high GDP growth of 8%, 175 GW of renewable energy and the Sustainable Development Goals (SDGs), are impeded by challenges like burgeoning population, falling water tables, high dependence on conventional sources of energy and low agricultural productivity. These challenges can however be met if 'FEW' is considered as a nexus.

This report, "**Food Energy and Water nexus for Livelihood Security of India**" portrays the need for recognizing the FEW nexus and its management as a means to achieve livelihood security. This need is evident in India by the resource constraints faced in these sectors, because of the demand side factors (such as overpopulation, rapid urbanization and industrialization) and supply side factors (such as dwindling resource stocks and climate change). While the necessity of a unified approach becomes ever more critical, there are some systematic challenges that might delay this uptake, including the lack of a universally accepted framework for FEW integration, low penetration of proven modern technologies, cross departmental and State Government coordination and more importantly, lack of proper financing structures.

Though the nexus of Food-Energy-Water is yet to be recognized formally by the Central or State Governments, a number of measures, both by the government as well as private sector propagate the integrated well-being of more than one sector. This is evident from the policy landscape of agriculture, water, energy and industrial sectors, where a number of forward looking policies ensure that achieving resource efficiency in the respective sectors does not lead to negative impacts in others. Similarly, business response to the externalities in FEW sectors have been encouraging, especially amongst industries highly dependent on FEW resources, like food processing, power and iron & steel.



Taking learnings from local and global application of FEW nexus approach, this report delves into the process of mainstreaming it in India, to not only provide efficient utilization of resources, but to generate livelihoods. Mapping the shocks and seasonality risks associated with livelihoods to the availability of the FEW resources, strategies for the implementation has to be holistic. Generation of livelihood opportunities would need to be enabled by cutting edge technology and its end to

end integration, guided by the policy and institutional framework. Leveraging latest technologies like Information Communications & Technology (ICT), Internet of Things (IoT), blockchain and other cloud based solutions to ensure efficient utilization of resources and supportive policy framework are enablers to such technologies.

Finance as a sustainability catalyst has a tremendous potential. Conventional financing tools, like subsidies and tax holidays, in conjunction with emerging tools and techniques, like Public Private Partnerships (PPP), blended finance and capital markets can act as facilitators of FEW nexus approach to generate livelihood.

For successful implementation of a nexus approach throughout the economy, framing enabling policies, establishing innovative business models and financing mechanisms, weighing the trade-offs and exploring synergies between the sectors and collaborations among all key stakeholders is imperative.

With the suggestions and opportunities presented, this report aims to focus the efforts of policymakers and businesses alike in recognizing the FEW nexus and framing appropriate response to ensure proper resource utilization and livelihood generation.

Namita Vikas
Group President & Global Head, Climate Strategy & Responsible Banking YES BANK
Distinguished Fellow YES Global Institute

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1 Introduction

1 Introduction

The year 2017 marked the 2nd anniversary of the adoption of the Sustainable Development Goals (SDGs) and the Paris Agreement. The world congression at the One Planet Summit witnessed policymakers, businesses and civil society unanimously reiterating the need for a low carbon and sustainable future. Incidentally, the year also witnessed losses of USD 330 billion from natural catastrophes globally, affecting 40 million people in South Asia alone during the monsoon floods (Munich RE, 2018). Clearly, the increasing rate of natural calamities, fueled by climate change, need dedicated efforts and cooperation from multiple stakeholders to secure the future of the planet and ensure well-being of future generations.

Globally, SDGs provide a blueprint for achieving transformational change, through collaboratively addressing development priorities in a resource constraint world. If we look at the shared challenges currently faced by the world, Food, Energy, Water and Livelihoods (FEWL) clearly emerge as cross-cutting thematic areas that will be instrumental in achieving 75% of the total 17 Global Goals. This makes consideration of Food-Energy-Water-Livelihood even more critical in the Indian sustainable development context.

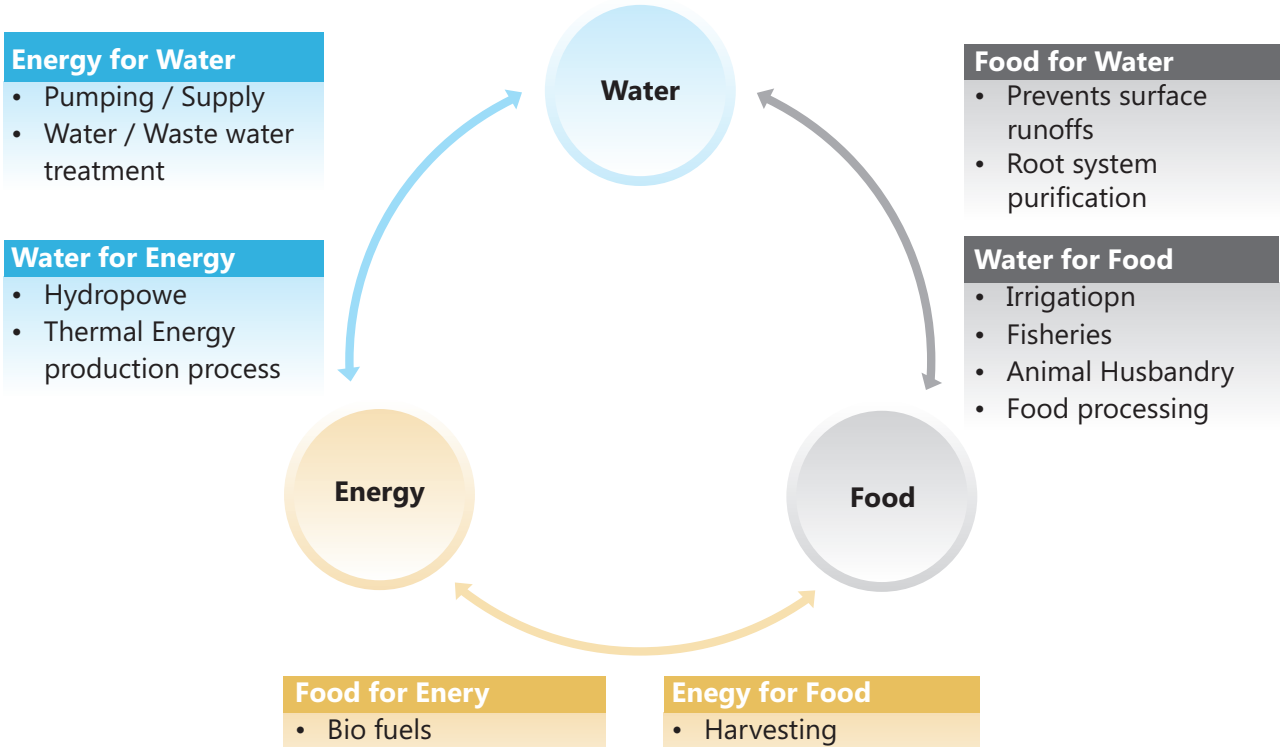
India has made rapid strides in socio-economic development in recent years and has emerged as a global power, with the country tipped to be the world's fastest growing major economy in 2018 (World Bank, 2018). However, the challenges of poverty, food security, clean water and energy access for all, still persist. Currently, India ranks at 100th position in the Global Hunger Index among 119 nations, worse than many smaller Asian peers (Global Hunger Index). Over 311 million Indians still live without access to electricity (Banerjee, et al., 2015) and 63 million without the access to clean sources of water for their daily usage in rural areas (Stewart, 2017). Additionally, per capita availability of land, water and other natural resources continue to shrink at an alarming rate, while the country's demand for critical resources is rising with the growing population. Fueling future growth for a young and growing population, without degrading natural resources, is indeed a fundamental development challenge for our country.

1.1 Food-Energy-Water nexus

Food-Energy-Water (FEW) resources are critical to human existence and industrial production, and their security is paramount to sustaining livelihoods in the country. These critical resources are inextricably linked to each other, with an action / intervention in one area often impacting others.

These two-way relationships between the three resources create challenges in managing them. Therefore, it is important that these sectors are viewed from a nexus approach to understand the considerations of their linkages and inter-dependence, essential for integrated resource management. This dynamic relationship among the food, water and energy sectors is depicted in the Figure 1 below:

Figure 1: Food-Energy-Water nexus



1.2 Need for FEW nexus approach in India

Achieving Food-Energy-Water security, amidst dwindling supply of land, water and other vital ecosystem resources, poses significant challenges for a developing country such as India. Grappling with issues of affordability and equitable distribution of Food-Energy-Water for all, India is poised to face an unprecedented demand for these resources. The various influencing factors or drivers of change affecting the demand and supply of FEW resources and the key trends are summarized in following table 1.

Table 1: Influencing factors for FEW Resources

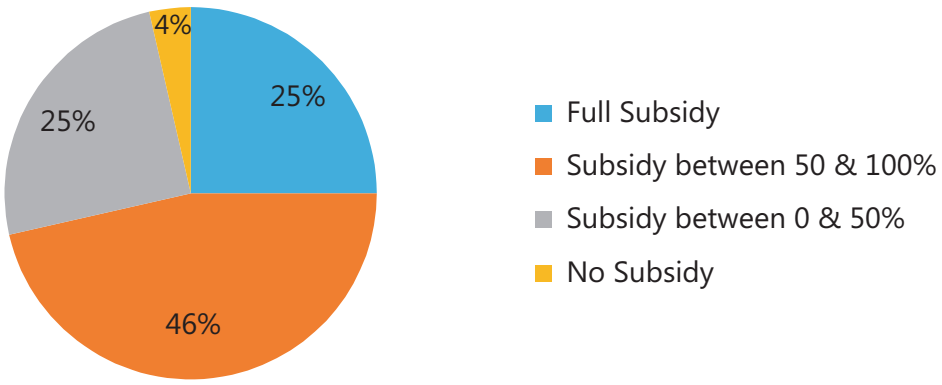
Factor influencing Demand	Key Trend
Population Growth	In the past 70 years since independence, population of India has more than quadrupled from approximately 330 million in 1947 to 1.34 billion in 2017 and is expected to increase to 1.51 billion by 2030, peaking at 1.68 billion by 2061 (UNDESA/Population Division 2017).
Rapid Urbanization and improved standard of living	India is moderately urbanized with 31.1% of population living in urban areas, which is expected to grow to 50% by 2051 (MoUD, 2017). Rapid economic growth has led to an improved standard of living for India with the per capita income growing by six times between 1990 and 2016 (World Bank, 2016).
Industrialization	India's ambition to increase the share of manufacturing in its GDP from 17.1% to 25% by 2022 (IBEF, 2017) is expected to further drive significant energy and water demand. The Indian agriculture is also expected to increase mechanization from the current level of below 50% (Business Today, 2016).
Resource Constraints	India is set to become a water scarce country by 2025 (study conducted by EA water), with per capita availability of water going down to 1341 m^3 in 2025 and 1140 m^3 in 2050 (PIB, 2017). India is heavily dependent on importing its sources of energy, with an import dependence of 34.3% of total energy use, which is expected to go up to 59.3% by 2047 (Niti Aayog, 2015). India's crop yield of 3721 kg/ha is much lower than the world average of 4548 kg/ha, requiring additional land resources to meet its growing food needs (NITI Aayog, 2015). Ground water, which forms the major source for fresh water, is depleting at an alarming rate.
Climate Change	Recent studies at the Indian Agricultural Research Institute indicate the possibility of a loss of 4-5 million tons in wheat production in the future with every rise of 1°C temperature throughout the growing period (Shrivastava, 2016). Rice production is slated to decrease by almost a tonne per hectare if the temperature rises by 2°C (Shrivastava, 2016). Many power plants in India, such as the 2600 MW Tiroda plant in Maharashtra, had to shut down temporarily in 2016 due to a lack of water, with such instances likely to increase in future (IEA Clean Coal Centre, 2017).

These influencing factors exert pressure on India's resource consumption, especially the FEW resources. With competing demand for these inter-linked resources, an important aspect of effective management and driving efficiency, while minimizing negative trade-offs, would be to minimize conflicts among the three resources. Instead of managing food, energy and water in silos through stand-alone policies and funding instruments, promoting greater synergies is required to promote integrated and holistic cross-sectoral development.

An instance of the nexus impact of policies taking a 'silo' approach is the traditional support of State policy towards improving yield, through subsidization of agriculture inputs including power for pumping water, in the form of electricity and diesel and agricultural inputs like fertilizers and chemicals.

The energy tariffs for irrigation purpose have been heavily subsidized, with 20 States subsidizing it more than 50% and just one State of Tripura charging more than average cost of power from agriculture (Figure 2).

Figure 2: Indian states subsidizing electricity for farmers, (IndiaStat 2014) (*calculations based on 28 states present in 2013-14)



Such policies have led to depletion of water resources and misuse of electricity, and have not been able to improve the agricultural productivity beyond a threshold (NITI Aayog, 2015). Groundwater pumping and other agricultural practices account for 17.3% (MOSPI, 2017) of total electricity consumed in the country, and the groundwater table has seen depletion in 65% of the wells tracked (CGWB, 2016).

It is apparent that the conventional approach of individually managing Food-Energy-Water is not the best option in view of the rising strain on these resources. On the contrary, an integrated FEW nexus approach opens up new opportunities that can be leveraged through adoption of innovative technologies and solutions. For instance, 'System of Rice Intensification' is a technique of rice cultivation without flooding fields, which has benefitted farmers in Andhra Pradesh, Tripura, West Bengal, and several others states. The technique provides higher yield of rice, while requiring half the amount of water. This comprehensive technological and implementation push by state policies provides a clear and compelling case to look at Food-Energy-Water holistically.

1.3 Implementation Challenges

Adopting a FEW nexus approach from a policy and corporate strategy standpoint has clear advantages. However, the progress towards implementation has not been very fast paced and the scope has been limited. Some of the barriers towards mainstreaming this approach include:

- Lack of a universally accepted framework for FEW integration: Various studies have explained the nexus and the multiple interdependencies, but evaluation of project / policies against a nexus approach remains limited (Pittock, et al., 2015) (Endo, et al., 2017) (Endo, et al., 2015). The frameworks available present a qualitative evaluation of the impacts (Rasul, 2016) on various economic activities or are very strongly related to a particular implementation. A simpler framework for evaluating the risks and opportunities may be needed for deeper understanding of the nexus approach among decision makers and businesses alike. The frameworks may also provide simple comparison amongst the available solution choices

- Low penetration of proven modern technologies: The penetration of FEW effective modern technologies is still very low in India. For example, India has just 5.5% integration of Micro irrigation systems, (ICAF, 2015) which are proven to have multiple benefits including saving in terms of water and energy and increasing area under irrigation. There is a clear need to assess the barriers in adoption of efficient technologies and address them for large scale penetration

- Cross departmental and State Government coordination: The interdependencies amongst the FEW resources make it imperative to work across different departments and ministries. The FEW resources also involve both Central and local Government departments in effective management. Therefore, a nexus of departments, or a steering committee of different authorities may be required for effective impact assessment and decision making

- Lack of proper incentive structures and enhanced financial viability: The incentive structures needs to be reoriented to promote synergies between the inter-dependent sectors and all the actors should come together with their blended expertise to commit financial support in piloting and scaling financially viable and environmentally sustainable projects

Thus, in order to surmount the pressing need of managing resources, economy and livelihoods more effectively, nimble policies coupled with innovative business solutions are required to overcome implementation challenges and create an enabling environment for effective transition to a sustainable Food-Energy-Water nexus approach.

2 FEW nexus Approach in India

2 FEW nexus Approach in India

The constraints on Food-Energy-Water resources, with apparent impacts on the livelihood have stimulated both the Government and corporates to start integrating the nexus approach for promoting resource efficiency. This is evident from the current policy landscape and business responses.

2.1 Policy landscape

Livelihood generation and improvement has always been at the center of the policy objectives of both the Central and State Governments. As agriculture remains the backbone of livelihoods in the Indian economy, with 44.3% of the population (World Bank, 2017) being dependent on it directly or indirectly, and agriculture being the biggest consumer of water, the FEW policies are of immense importance in the sector. India is also witnessing the manifestation of FEW nexus aligned policies in other sectors including energy, water and industries. The recent budget for FY 19 also highlighted the policy emphasis on improving farmer income.

FEW nexus approach in Agriculture

Given the need for resource efficiency in the agriculture sector, and to enhance the livelihood of farming families, Government has undertaken radical policy initiatives including Hon'ble Prime Minister Shri Narendra Modi's call for 'More Crop, Per Drop'. Consequently, the new agriculture policy (RRTD, 2017) earmarked sustainable agriculture and effective utilization of water and chemical inputs as one of the key objectives.

National Mission on Sustainable Agriculture (NMSA)	• Focus on creation of climate resilient production systems for crops and animal husbandry • Identifies 10 key dimensions for promoting suitable agricultural practices • 'Water use efficiency', 'Nutrient Management' and 'Livelihood diversification' form 3 important dimensions
Pradhan Mantri Krishi Sinchai Yojana	• Focus on 'Har Khet Me Pani' and 'More Crop Per Drop' • 99 major/medium irrigation projects (irrigation potential of 76.03 lakh ha) have been identified for completion in phases by December 2019 • Enhance adoption of precision-irrigation and other water saving technologies
National Project on Organic Farming (NPOF) & Paramparagat Krishi Vikas Yojana (PKVY)	• PKVY promotes organic farming through a cluster approach along with Participatory Guarantee Scheme (PGS) to ensure the integrity of products • NPOF focus on providing the necessary capacity building, standards creation, quality control and low cost certification of organic produce
Soil Health Management (SHM)	• Promote Integrated Nutrient Management (INM) through appropriate use of chemical fertilizers and regulation of micronutrients to boost production • Soil Health Card are used to recommend ways to improve the soil quality, decide appropriate dosage of nutrients for improving soil health and fertility
National Mission on Agricultural Extension and Technology (NMAET)	• Focus on restructuring and strengthening agricultural extension of modern efficient technologies • Promote use of Information and Communication Technology (ICT) and popularization of modern technologies to increase efficiency • Capacity building and institution strengthening to promote
Solar Photovoltaic Water Pumping systems for Irrigation	• Provide capital linked subsidy schemes for solar pump adoption • Initial target of 1,00,000 solar pumps across India with financial support of INR 400 crores • 31,472 solar pumps installed in 2014-15, higher than total number of pumps installed in the last 24 years

FEW nexus approach in Energy

India is primarily dependent on fossil fuels to meet its energy requirement, with electricity generation capacity mostly being thermal. But in the recent past, India has witnessed a surge in the renewable energy mix that aligns with the FEW nexus approach to a great degree. With multiple benefits including addressing energy security and very low water consumption compared to fossil fuel technologies, renewable energy is being fuelled by ambitious targets and supporting policies.

Supporting Renewable Energy Policies

- Ambitious renewable target of 175 GW capacity by 2022, contributing to 6% of the total power supply (IESS)
- Policies like Jawaharlal Nehru National Solar Mission (JNNSM) and establishment of solar parks have been instrumental in creating a favorable environment

New Hydro Policy (Draft)

- Seeks to declare all hydro power as renewable energy, irrespective of its size
- Hydro Power Obligation benefit to projects attaining Commercial Operation Date (COD) within specified period
- Interest subvention during construction / post commissioning with funding pattern on grant basis

National Policy on Bio-fuels (Draft)

- Use of surplus food grains to augment production of Ethanol
- Indicative target to blend 20% ethanol in petrol and 5 % bio-diesel in diesel by 2030
- The policy also encourages production of second generation biofuels through viability gap funding

India's renewable energy push has created 6,21,000 employment opportunities in 2016 (IRENA, 2017) and is expected to generate more than 3,30,000 new jobs over the next five years. Renewable energy holds enormous potential to tackle poverty in rural communities by providing steady incomes, healthcare benefits, and skill-building opportunities to unskilled and semi-skilled workers (CEEW, 2017).

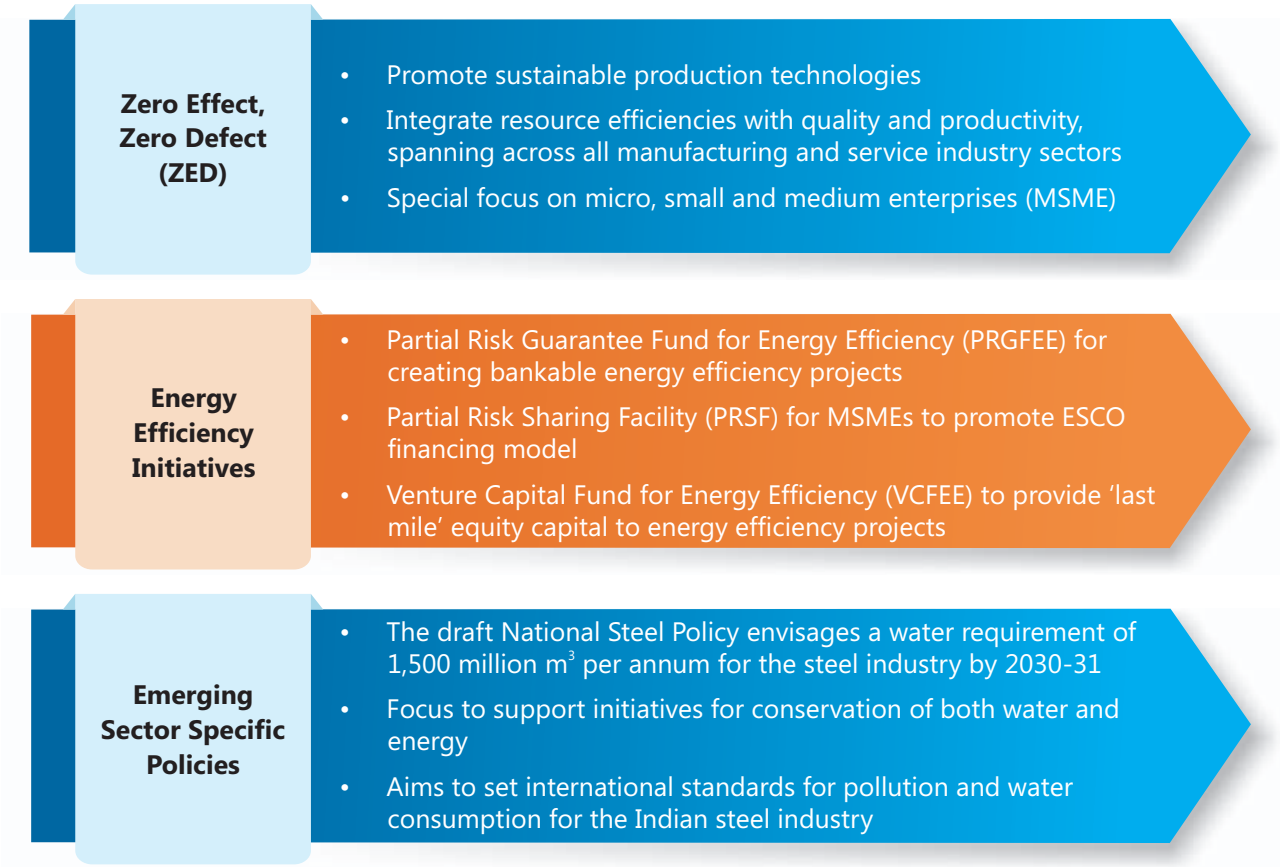
FEW nexus approach in Water

Among the FEW resources, water is the most vulnerable resource, and has led to conceptualization of schemes, policies and programmes in water sector, that align well with the FEW nexus concept. Some important ones are:

The water policies have been concentrated on enhancing the availability of water for drinking and agricultural purposes, with multiple impacts such as creation of alternative occupation opportunities like fisheries, tourism, and transport, thereby boosting livelihoods.

FEW nexus approach in Industry

Industries are crucial in livelihood creation and economic growth. With the growing resource scarcity and impacts of climate change, Government has been active in strengthening the sector through augmenting productivity, while addressing resource inefficiencies. MSMEs form the most important sub-segment to focus on, with over 51 million units in India and accounting for a workforce of 117 million (Ministry of MSMEs, 2017).



Augmenting resource efficiency while limiting environmental impacts has been the cornerstone of FEW aligned policies in industries.

2.2 Business Response

The corporate sector is a bulk consumer of Food-Energy-Water for its processes, while also generating livelihoods and contributing 29.02% share to India's GDP (Statistic Times, 2017). The sector has been key to transforming these FEW resources and creating a variety of products for human consumption. FEW resources is a key cost driver in corporate processes, and their security remains of paramount importance to the survival of these industries.

Indian corporates have also started taking note of the risks associated with the scarcity of FEW resources. As per a survey conducted by Carbon Disclosure Project, 55% of respondents believed that water is impacting their business and more than half of the reporting companies had a water policy, strategy or management plan in place (CDP, 2014).

Some of the industries which face immediate scarcity of FEW resources, and their response to this scarcity is discussed:

Food processing

Food processing is one of the key industries which improves the life and quality of food available for human consumption. The Ministry of Food Processing Industries has identified it as high water and energy consuming industry (MOFPI, 2017) having a significant environmental impact. The

companies have initiated innovation for conservation of these resources through focused action, to entail multiple business benefits like reduced cost and reduced risk from future scarcity. Some of these include:

- Saving water and energy by migrating towards low water consumption processes
- Using organic food waste to generate biogas
- Recycle waste water for alternative industrial / irrigation processes

Dabur striving for resource efficiency including water and energy

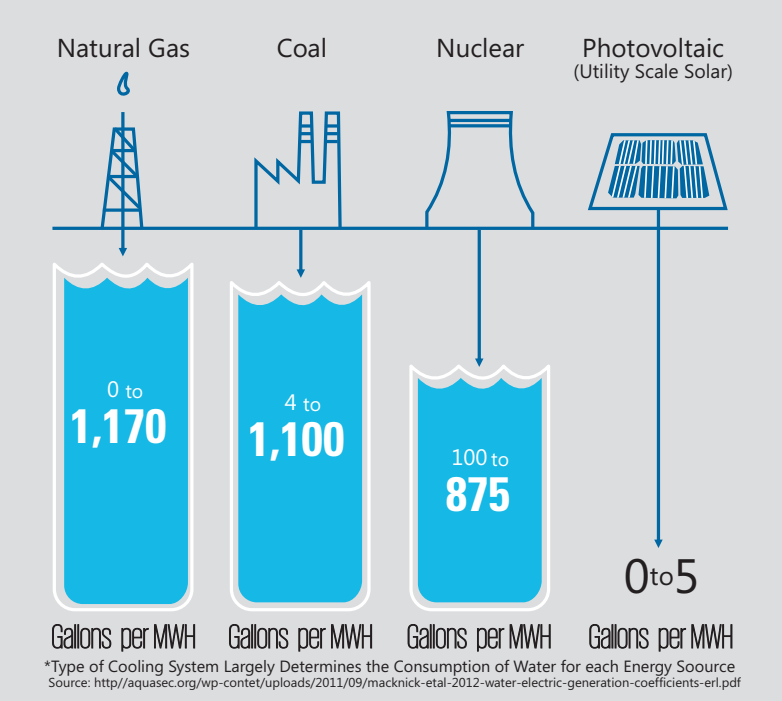
Dabur India Limited (DIL), one of the leading food processing companies in India, has been working aggressively for water and energy stewardship. In FY-16-17, DIL has taken steps to reduce water consumption in their manufacturing operations through establishing Effluent Treatment Plants (ETP) to recycle and reuse water and to ensure that no water is discharged outside the boundary. Over the FY 2015-16, DIL has substantially reduced its raw water consumption by 11%, increased treated effluent reuse and recycle by 9%, reduced hazardous waste generation by 47% and increased energy efficiency leading to 24% reduction in greenhouse gas emissions. These productivity improvement and resource saving initiatives have resulted in savings of INR 3 Crores for the company (Dabur India Limited, 2016-17).

Power

Power generation is one of the most water intensive industries and depends heavily on water security. The various sources of power account for different water usage in their production and cooling process (Figure 3).

Figure 3: Water operational use by energy type

Water Consumption for Operational use by Energy Type



*Type of Cooling System Largely Determines the Consumption of Water for each Energy Soource
Source: http//aquasec.org/wp-contet/uploads/2011/09/macknick-etal-2012-water-electric-generation-coefficients-erl.pdf

The sector has also realized the extensive cost of water in power generation and has been using technology-based solutions including:

- Changes in cooling technology, from Cooling Towers (highest consumption) to water efficient cooling technologies like Dry Cooling (lowest consumption)
- Use of grey water for cooling technologies
- Changes in energy mix from thermal based generation to renewable based generation

National Thermal Power Corporation (NTPC) diversifying into renewables

NTPC has started focusing on renewable energy for diversification, considering their abundant supply and least environmental impacts. In FY 2007, NTPC's 27 GW power generation capacity was based only on fossil fuels. Now, with ambitions of evolving as the country's largest green power producer, NTPC's present 51 GW capacity includes 12 renewable energy projects (NTPC, 2017).

Iron & Steel

Iron and Steel industry has very high consumption of two critical resources of energy and water. The energy consumption of Indian steel plants ranges in 6 - 6.5 Giga Calorie per tonne of crude steel, as compared to 4.5 - 5 in steel plants abroad (Ministry of Steel, 2017). Various initiatives taken by the industry to reduce water and energy intensity of the sector include:

- Improvement of water use efficiency in processes (using software and state of the art tools to measure water consumption in processes)
- Switching to high energy efficient technologies which also reduce water consumption

Tata Steel adopting green technologies in steel making

Tata Steel has commissioned several energy efficient and environment friendly technolgies in order to reduce its input costs and environment impacts, while boosting productivity in steel making. It has re-established its environmental stewardship in steel manufacturing with introduction of India's biggest clean coke producing facility at Kalinganagar Industrial Complex in Odisha (BusinessLine, 2017). This facility is commissioned with environment friendly Coke Dry Quenching (CDQ) unit that use an inert gas to cool hot coke, replacing conventional water spray method which results in high CO_2 emissions and thermal energy loss. The process is supported by waste heat recovery system to generate electricity from the captured heat, increasing resource efficiency considerably. This environment-friendly technology will help in reducing carbon-dioxide emission to the extent of 0.11-0.14 tonnes per tonne of coke and dust emission to the tune of 300-400 gm per tonne of coke.

Other manufacturing industries including pulp and paper, cement and textiles have also adopted modern practices and technologies to manage their food, energy and water consumption. The service sector has also been active in reducing their food wastage, water and energy consumption. Industries operating from commercial buildings are adopting green building codes, which reduce the energy and water consumption considerably in the building.

Though the FEW nexus approach has made its way into the policies and strategies of both the public and private sector, it remains in its incipient stage, requiring further action in scaling up FEW interventions and approach across the economy.

3 Global applications of FEW nexus approach

3 Global applications of FEW nexus approach

Governments and the corporates are natural partners in incorporating the FEW nexus approach in most socio-economic processes. While we have seen how the policies and strategies have been directed towards achieving resources efficiencies, a multi-stakeholder collaboration may be required for reaping all the benefits of the nexus approach.

The following section presents four case studies from India and across the globe on how applying technologies and processes with incorporation of FEW factors and working with diverse stakeholders has led to multiple benefits. These projects solve multiple FEW issues, and serve as replicable and scalable solutions based on a nexus approach, with clear livelihood impact.

Case Study 1: India

World's first solar irrigation farmer cooperative

Dhundi is an agrarian village in Kheda district of Gujarat. Water for irrigation is provided mainly by pumping groundwater. This pumping is undertaken either through subsidized electricity at INR 0.7/kWh, prone to over use, or through diesel powered pump sets sold at a very high price of INR 400/ bigha/ watering, reducing agriculture margins. The introduction of solar pumps to reduce the subsidy burden allowed the pump owner to sell water at INR 200 / bigha / watering leading to over use of ground water resources. In order to provide sustainable water pumping solution, by reducing dependence on subsidized electricity and also reducing groundwater wastage through sale of excess electricity (Business Standard, 2017), the State Government with its discoms introduced the net metering policy to allow the farmers to sell excess electricity back to the grid. To leverage this opportunity, a farmer-led initiative Solar Pump Irrigators' Cooperative Enterprise (SPICE) came together to install six solar pumps with a total capacity of 56.4 kWp. The members contributed INR 5,000/kWp for the installation of the pumps, with the

rest being undertaken as a research grant by International Water Management Institute (IWMI) and Consultative Group on International Agricultural Research (CGIAR) Research program on Climate Change, Agriculture and Food Security (CCAFS) (Tushaar Shah, 2016). The Cooperative also signed a 25-year Power Purchase Agreement with Madhya Gujarat Vij Company Limited (MGVCL) at INR 4.63/ kWh to sell excess electricity back to the grid. The revenue generation from the solar pumps nudges the farmer to use the water pump only till it is required, and feeding back the rest to the grid, creating incentive for efficient use of groundwater and energy resources.

The project led to multiple benefits for farmers, since the 56.4 kWp installation is expected to generate 85,000 kWh/year, of which approximately 40,000 units would be used by the farmers and the other 45,000 units could fetch the farmers an additional income of INR 3 lakh per annum, which was more than the their investment in the first year itself. The irrigation from the pumps and further income from selling power would be available to the farmers free of cost for next 25 years. The utility saves on the subsidized power for which it has to bear the cost of INR 4.5 / kWh, against a recovery of INR 0.7/ unit. In a span of 25 years, MGVCL can save upto INR 8.17 lakh per annum and generate renewable energy from the net metering for complete 85,000 kWh. The solar pumping sets also save the carbon emission from diesel pumps / grid electricity. The case study depicts that enabling policy (net metering), financial support (subsidies and grants) and community involvement has enabled better irrigation for farmers, saving ground water and promoting clean energy, while also providing an additional source of income for farmers.

Case Study 2: Mexico

Leveraging Water – Energy linkages to achieve efficient water management, energy utilization and livelihood generation (WaCClim, 2017)

Mexico's urban water management sector contributes significantly to its overall greenhouse gas (GHG) emissions. Considered together, drinking water, wastewater and end user heating contribute up to 5% of Mexico's total GHG emissions. Given the growing urbanization, the utilities across Mexico were not able to provide basic water and waste water collection services at affordable price to users. Water and Wastewater Companies for Climate Mitigation (WaCCliM) piloted a project with a water supply service agency and a wastewater treatment plant along with the support of Government bodies and relevant departments. The project interventions at the international level involved creation of Energy Performance and Carbon Emissions Assessment and Monitoring (ECAM) tool to quantify emissions from the sector. At the national level, improved political, regulatory and institutional framework was developed like putting national mitigation targets for Water and wastewater sectors, including indirect carbon emissions from energy efficiency measures in pumping and aeration process to feed into Mexico's NDC targets (Mestre, 2015). These interventions were backed by introducing appropriate financing instruments for adoption of energy efficiency and developing partnerships among utilities to strengthen their capacities and technical know-how. At the utility level, capacity building was undertaken, technology upgradation in terms of energy efficient pumps and activated sludge technology for producing biogas from wastewater was installed and ECAM tool was used for continuous tracking.

All these interventions led to increased wastewater coverage for an additional 52,000 inhabitants; wastewater collection and treatment increased from 48% to 81%, reduced emissions equivalent to 2,500 tCO_2e/ year, biogas production of 400 Nm^3 / year (energy saving of 71 MWh / year), reduced energy use by 20% and 31,600 m^3 / year wastewater reused.

The case highlights the interdependence in usage of energy and water in an urban set up and an integrated approach to use municipal wastewater to generate electricity through generation of natural gas and further channelization of water for other urban / industrial purposes. The reduced cost to utilities and increased penetration of water services provided better lives & livelihoods for cities in Mexico.

Case Study 3: Kenya

Renewable Energy Solutions for Lake Victoria Ecosystems (RESOLVE)- Bringing Wind/Solar power to Lake Victoria fishing communities (Renewable World, 2017)

The region near the lake Victoria is non-cultivable and the population depends on fishing for their livelihoods. The fishing also has to be done during the night as the days are hot and sunny. Additionally, due to absence of adequate preservation techniques, the fish produced gets spoiled before reaching the consumer. The region is not connected to the grid and power source is a critical limiting factor for the community's social and economic development. In order to improve the livelihood of Kenyan fisherman community, six micro grids were installed to power deep freezers. The involvement of the community was ensured by establishing Community Based Organization (CBO) to manage and maintain the energy hubs in each community and formation of Savings and Credit Cooperative (SAACO) to provide a mechanism that coordinates learning, improves collective savings & cross lending across the communities and attracts external financing for the maintenance and development of new energy hubs.

The project has been instrumental in alleviating the livelihood and living conditions of the entire fishing community of the region, as they now have access to freezers to keep their stock fresh. As a result, the average household income levels have increased by 9.4%. Average monthly expenditure of a household on energy for lighting has decreased by more than 50% and use of solar-charged lantern for night time fishing has improved the health and safety of the fishermen by removing the kerosene pressure lamps from boats.

Case Study 4: Australia

Addressing the complete Food-Energy-Water nexus while sustaining local livelihoods by Sundrop Farms

Port Augusta is situated in an arid, dry climate of Southern Australia, with degraded pasture lands unfit for conventional agriculture. The lack of available resources has enabled Sundrop Farms to produce vegetables sustainably on a 20 hectare facility by using a number of innovative technologies in conjunction. The farm utilizes a solar thermal unit with 25,000 computer controlled mirrors to generate electricity to run the farm, desalinate the seawater to produce fresh water and salt and use the waste heat to control the temperature of the green house. The freshwater produced is used for irrigation of tomatoes and high productivity is ensured through temperature controlled greenhouses.

As a result of these interventions, the facility produces over 16,000 tons of carbon neutral, freshwater neutral tomatoes annually. About 260 jobs were created during the expansion of the farm, and the farm employs 200 employees for day-to-day operations (Bookmyer, 2016). Sundrop's technology achieves significant energy and pollution savings compared to traditional methods including approximately 26,000 tons of carbon dioxide per year (equivalent to removing 500 cars from our roads), more than 450 million liters of freshwater per year (equivalent to 180 Olympic size swimming pools) and more than 2 million liters of diesel per year (equivalent to driving a car around the equator 500 times). The integrated solar thermal power plant is an excellent example of innovative technology, which can transform the landscape through active support from private sector, investors and policy makers and align with the FEW nexus to generate livelihoods as well as business profit.

Based on the various insights from the four case studies, the next section focuses on steps that India can take to ensure adoption of FEWL nexus becomes a norm, rather than an exception.

4

Mainstreaming FEW nexus Approach for Livelihood

4 Mainstreaming FEW nexus Approach for Livelihood

Food-Energy-Water resources are required for a range of domestic, industrial and environmental purposes. Availability, accessibility and affordability of any of these resources can act as a limiting factor for proliferating livelihood opportunities, thereby restricting economic growth. Rapid industrialization, urbanization and population growth in India leading to an increased demand for FEW resources has resulted in growing pressure on the fast depleting natural resources.

4.1 Risks and Vulnerability Context

Given the inter-linkages and constraints, livelihoods across India are drastically affected in terms of sustainability and shocks. Typically, shocks are categorized as household level or idiosyncratic shocks and community level or covariate shocks. While idiosyncratic shocks include illness, injury and unemployment; community level shock include disasters, epidemics and conflicts. Further, macro-environmental or national level shocks may impact livelihood opportunities due to sudden variances in energy resources' costs and their availability, impact of resource imports/exports, change in political leadership and regulatory framework.

Risks and Vulnerability
1. Shocks
a. Household Level
b. Community Level
c. National Level
2. Seasonality / trends

Apart from the one-time impact of shocks, the resources are also subject to a variety of trends and seasonality. Major driver for estimating the future demand for food, water and energy is the impact of weather conditions, as weather plays an important role in the fluctuation of energy consumption throughout the year. Additionally, the variability of daily water consumption during summer season is 1.2 – 1.6 times higher than the average annual daily consumption (A. Hussien, et al., 2018). While the seasonal variability for water and energy is documented, most studies address only the consumption during a particular period of the year (Costa et al., 2013). The seasonal variability in food consumption is expected to be greater specifically in the developing countries, where the price of the most food commodities varies seasonally (Leonard and Thomas, 1989).

4.2 FEW Resource Assets

The extent of FEW resources determines the growth and livelihood opportunities that a nation or society would support. While these natural assets / resources may provide a foundation for growth, it would require the following assets / capital for its optimal utilization Twigg, 2015:

- **Human Capital**: skills, knowledge, ability to labour, good health
- **Physical / Manufactured Capital**: livestock, transport, tools and equipment, shelter, water supplies and sanitation
- **Financial Capital**: income and savings, earnings, credit, remittances
- **Social Capital**: networks and connections, membership of groups, relationships of trust, reciprocity and exchange, political systems and governmental processes

Further, livelihood enhancement and management strategies need to be aligned to policies, processes and institutions. The focus of these policies, process and institutions is to reduce livelihood related risks while promoting resilient opportunities by anticipating and planning for changes of different kinds and adapt to them. Such interventions should build on existing coping and livelihood strategies.

The Union Government has already embarked upon the ambitious plan of doubling farmer income as a part of enhancing livelihood security for over 80 million (PIB, 2017) farming families, dependent of agriculture. This is a landmark step which integrates FEW with livelihoods. In the past, the focus has been on improving agriculture output and achieving food security, which resulted in India's food production growing by 3.7 times and 45% increase in per person food production (Chand, 2017). Theoretically, it may imply that with the high growth of farm output, the income of farmer would also have increased. However, this is not a generic trend which was observed, as the farmer incomes did not grow in proportion to the increasing output. A recent study reveals that over 33% of farmers in Punjab are below poverty line (Pandhi, 2017). Earlier in 2014, a similar study revealed that 80% of farmer in Haryana are under poverty line (Sharma, 2014). National Sample Survey Office (NSSO) data further suggests that over 22% of Indian households employed in farming are under poverty (Chand, 2017).

4.3 Strategies for improving livelihoods – FEW Approach

Ensuring sustainable livelihood for all requires strategic planning and execution of a holistic strategy, which can improve livelihood opportunities and address vulnerabilities. Generation of livelihood opportunities need to be enabled by coupling technology and finances, guided by the policy and institutional framework.

Development initiatives and policies to drive improved productivity:

- Access to quality seeds, fertilizers and pesticides for improved yields
- Availability of irrigational water
- Reliable electricity supply
- Support to produce more than one crop/livestock

Technology improvement will be critical to achieving better yields through improved varieties, breeds, practices, knowledge & innovation and cost reduction. Government has deployed a network of 'Krishi Vigyan Kendras' in every district to provide last mile connectivity of technologies, developed by the public research

Technology, especially the digital technology can play a very important role in the allocation of resources through big data collection, storage and analytics. One of the biggest drawbacks in predicting demand and formulating related policies is the lack of data. As the price of data collection technologies reduces through the use of modern sensors, India may utilize this opportunity to develop innovative technologies for collection, analysis and effective utilization of this data. For example, the amount of water required for crops in different months, and electricity generated through hydroelectricity and thermal power plants can help prioritize the flow of water based on the value derived from each activity, thereby reducing the impact of seasonalities.

Leveraging Information Communications & Technology (ICT), Internet of Things (IoT), blockchain and other cloud based solutions should be the next step in the nexus approach. For example, a WATERIG hub is a decentralized water and energy collection point. Such tech-based, connected and decentralized systems ensure transparency in allocation of resources and can be scaled to achieve resource efficiency through a nexus approach. Adequate financial support from Government and private sector is required for such technology solutions to become more widespread in India.

Blockchain powered Water-Energy Hubs (Dale, 2017)

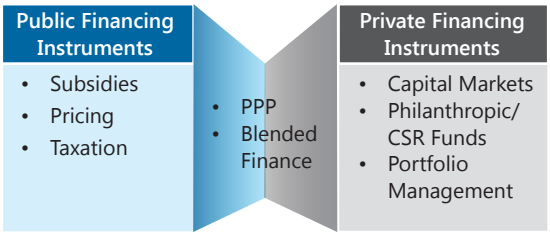
The winner of the Massachusetts Institute of Technology (MIT) SOLVE Sustainable Urban Communities challenge, WATERIG is a start-up company that focuses on developing decentralized water and energy solutions. A water and energy collection hub can collect energy from the surrounding environment including solar, wind, waste energy and ground cooling, which is used to produce 2,000 litres per day. Modules around the hub can be provided with access to that energy and water for vertical farming, greenhouse growth, rainwater processing, water purification, and algae farming.

WATERIG has incorporated 2 blockchains for:

- Tracking the ownership of each hub, enabling community-level crowdfunding and micro-ownership, **without a central authority**
- Collecting data on water, food production, and usage transactions by its members to grow a local

While NITI Aayog suggests that growth of livelihoods would require policies, development initiatives and technology dissemination, finance is bound to play the role of sustainability catalyst.

4.4 Finance as a Sustainability Catalyst



Availability, accessibility and affordability of finance remains a key enabler for the implementation and mainstreaming of FEW nexus approach, especially so in the developing economies like India. A recent report by International Finance Corporation titled 'Climate Investment Opportunities in South Asia' estimates climate-smart investment potential in key sectors is more than INR 3 trillion from 2018 to 2030. The report further suggests that the investment potential of renewable energy, urban water management and climate smart agriculture in India stands at USD 448 billion, USD 128 billion and USD 194 billion respectively. Given this enormous potential of the market, both the public and private sources of finance needs to collaboratively enhance mobilization of funds towards sustaining India's FEW resources.

Conventional financing tools

The traditional public financing options, which include subsidies, rates and taxes, would be crucial in addressing the behavioural impediments present in the market:

- **Subsidies**: Central and State Government have been utilizing subsidies as a policy instrument for social development by improving access to products, predominately in agriculture, energy and water sectors. Many of these subsidies have led to indiscriminate use of these resources by the consumers or producers, leading to unsustainable production and consumption. This is evident from energy and fertilizer subsidies that have led to significant depletion and pollution of water resources. Weighing these policies from a FEW perspective suggests phasing out such subsidies on account of inefficiencies, while promoting effective techniques such as micro-irrigation

- **Pricing as a tool for demand management**: Pricing of services and products serves as an important tool for Government to provide access to resources to weaker sections of the society. However, if the prices are reflective of the true cost, including the cost arising out of negative externalities, demand of such resources could be managed and shifted towards FEW nexus aligned products, services and discourage inefficient usage

- **Tax holidays**: Sector specific tax holidays incentivize investments towards FEW nexus aligned sectors and businesses, which may be phased out once the market segment is matured. The adequacy and effectiveness of such mechanisms in drawing private capital has been exhibited in India in the case of renewable energy sector

Emerging Financing Tools for FEW

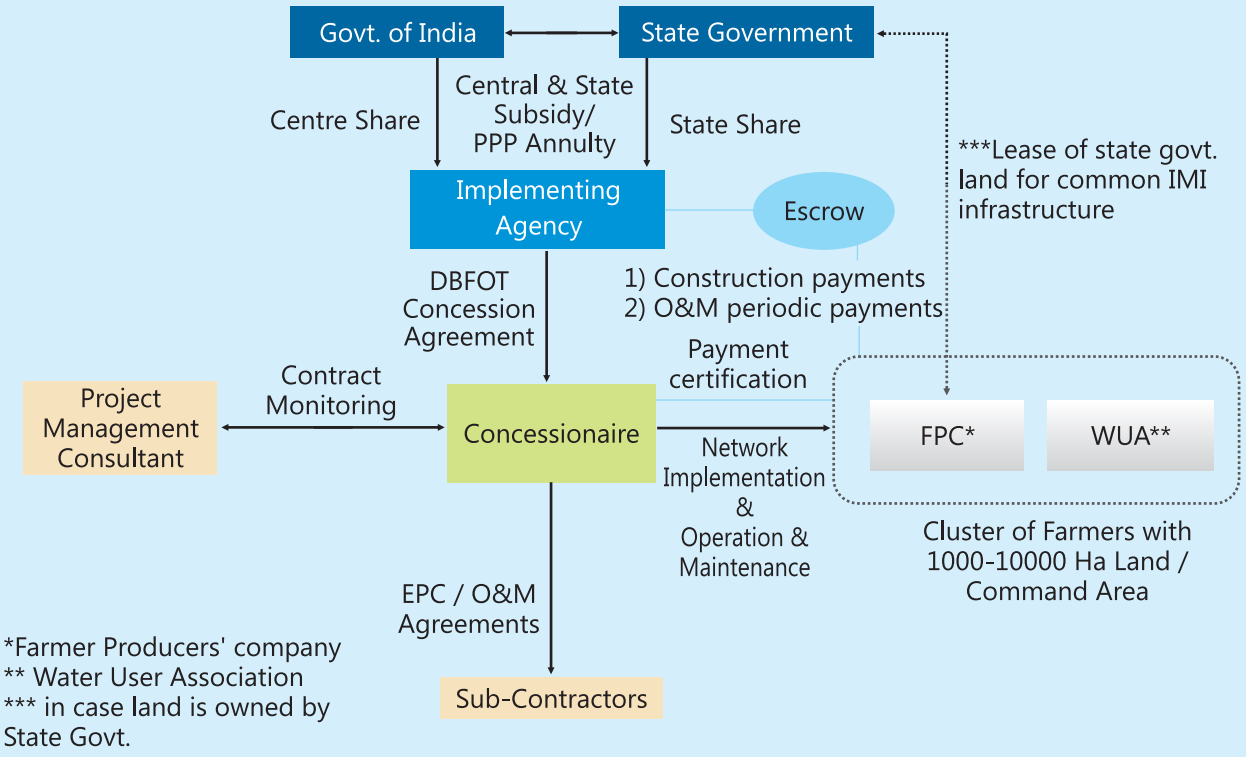
Given the need for mobilizing large volume of funds, private finance backed by public finance must be leveraged to maximize resources. Private players have to provide ideation and realization of innovative financing mechanisms and business models. Some of the emerging financing options for private sector participation in channelizing finances are:

- **Public Private Partnership (PPP):** For a growing nation like India, there is a strong need for upgrading its infrastructure services and leapfrogging towards the most efficient infrastructure. Public private partnership serves as an effective mechanism in achieving these, especially through transformations in agriculture and water sector where the investments remains low. The PPPs can be structured to ensure optimal financial returns for investors, while sharing the risks between the Government and the private partners. PPPs would not only be crucial in mobilizing the private capital, but also leverage the sector's functional and technical efficiencies

Innovative Public Private Partnership (PPP) model in Agriculture

In October 2017, NITI Aayog released draft Guidelines for Public Private Partnership for scaling micro-irrigation. The guidelines propose a PPP scheme where private players construct and maintain micro-irrigation projects, while farmers consolidate their farms to provide economies of scale to make private investment profitable.

Figure 4: PPP framework proposed by NITI Aayog for Integrated Micro-Irrigation (NITI Aayog, 2017)



As irrigation is a state subject, the PPP model would involve formation of State Implementing Agency (SIA) that would spearhead the initiative, serving as a single window for approvals and clearances.

The model proposes to pool in land holdings of beneficiary farmers through formation of Farmer Producer Companies (FPC) that would fall under active Water User Association (WUA) or under the command area of an irrigation canal. This, in turn, ensures sustainable source of

water for projects apart from economies of scale. Project Proponent, a private player selected by FPC, would work in close co-operation and provide guidance in pre-bid activities before selection of the Concessionaire.

The Concessionaire will undertake construction, installation, maintenance and management of the Integrated Micro-Irrigation (IMI) network and will transfer the asset to State Government after 15 years, under a Design, Build, Finance, Operate and Transfer (DBFOT) Concession Agreement.

Construction and maintenance charges of the Concessionaire will be met by Government (contributions from both the State and Central) through capital and maintenance grants and if required through user charges levied on beneficiary farmers. These contributions will be put in an escrow account maintained by FPCs and out-come based disbursement would be made to the Concessionaire post verification from a Project Management Consultant appointed by State Government. The same escrow account will also be used to disburse subsidies for adoption of IMI under Pradhan Mantri Krishi Sinchai Yojana.

Under the model, Concessionaire would be encouraged to generate incremental revenue through additional services like contract farming, marketing of farm products and storage facilities.

With salient features of creating high economies of scale, promoting technical knowhow to farmers and performance based payment, the model holds enormous potential in effectively leveraging public and private finance for scaling up IMI adoption.

- Blended Finance: Despite the numerous opportunities in FEW aligned sectors, projects with lucrative risk-return profile, as expected by institutional investors may be less. In order to channelize the much needed private capital to fuel FEW policy objectives, blending with public or philanthropic finance could play a big role in addressing prevalent market barriers and perceived high investor risk. Multiple instruments in the form of long and short term concessional loans, credit guarantees and equity support for blending with private capital may be available from various agencies mainly:

    - **Developmental Financial institutions**: Multilateral Banks and Developmental Financial Institutions are constantly expanding facilities for financing and driving environmental and social impacts in emerging nations. This provides opportunities to leverage DFI funds in the form of credit guarantees that could have multiplier impact in finance mobilization by drawing in private capital.

      World Bank's Blended Finance Facility (BFF) for mitigating financial risks in agribusiness; Multilateral Investment Guarantee Agency's (MIGA) credit guarantee facility for mitigating political risks in SMEs agri-business, Asian Development Bank's (ADB) climate change fund for climate mitigation are example of few of such dedicated facilities that could be readily leveraged

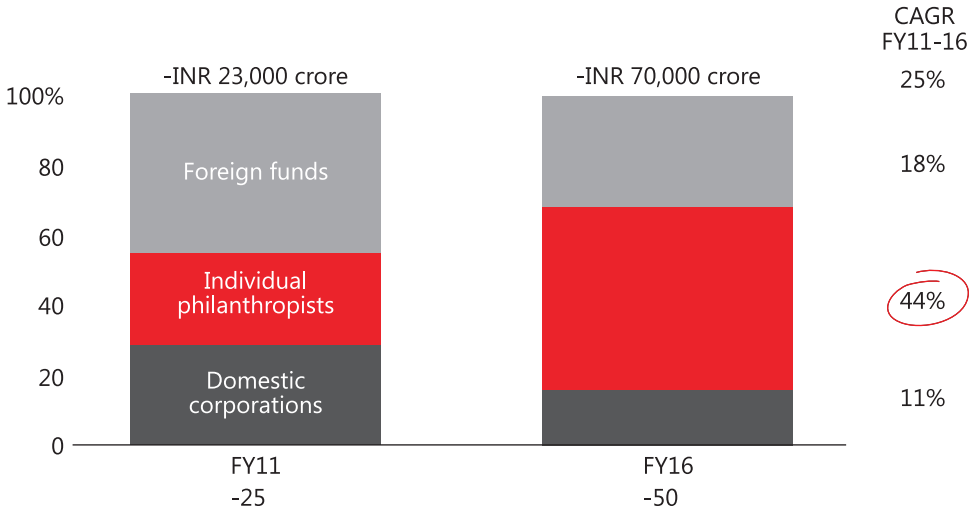
    - **Climate Funds**: Climate funds forms an important component in the financial mix, with the objective of channelizing finances from developed nations to developing economies for mitigation and adaptation measures. With prominent climate risks on FEW, climate funds become important in piloting and scaling up innovations aimed at leveraging the FEW interdependencies.

Table 2: Three largest Climate funds applicable for India (WRI, 2017)

	GREEN CLIMATE FUND	CTF CLEAN TECHNOLOGY FUND	gef
Thematic Focus	• Climate Adaptation • Climate Mitigation • Climate Resilience	• Climate Mitigation	• Climate Mitigation • Capacity Building
Financial instrments available	• Grants • Concessional loans • Risk mitigation • Equity		
Fund Value (USD bn)	10.3	5.4	9.5

- **Private Philanthropy:** Private philanthropy, due to relatively low level of risk-averseness and willingness to invest in innovative business concepts and financing models, is also emerging as a crucial source for blending finance. In India, in the past few years, there has been a surge in private philanthropy, which can be utilized to fund and mainstream FEW nexus interventions.

Figure 5: Private philanthropy emerging as a crucial source for financing development



Individual funds as percentage of private funds

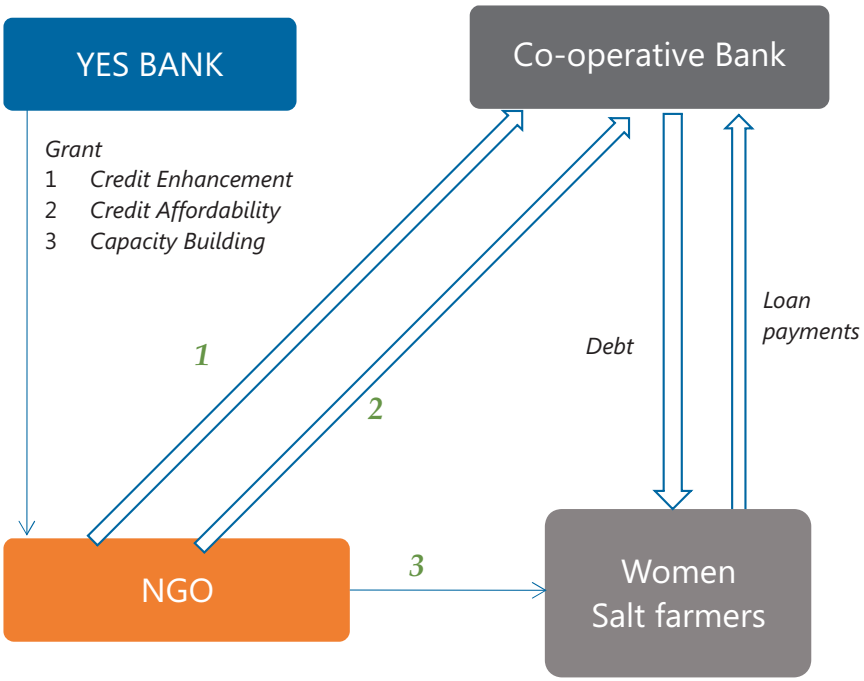
Sources: Ministry of Corporate Affairs; MacArthur Foundation and Intellecap; Economist Intelligence Unit; proceddings in the Parliament of India, Lok Sabha; articles and editorials from India's leading newspapers (The Hindu, Times of India, Economic Times, Mint, Business Standard and others); Bain analysis

YES BANK has developed a first-of-its-kind blended finance facility that addresses the multi-fold challenges of livelihood security, gender empowerment, financial inclusion and environment sustainability. The facility offers a financial innovation with a local co-operative bank and a local NGO implementing agency to facilitate access to mainstream debt finance to women salt farmers in Little Rann of Kutch, Gujarat. The project helps the farmer transition to eco-friendly solar pumps from energy inefficient diesel pumps.

The salt farmers draw brine using diesel pumps and evaporate it over salt pans to produce salt. Diesel remains a major cost to the farmers and in absence of mainstream working capital debt, the farmer is bound to pay exorbitant interest rates to the local moneylender. This leaves very low margins for the farmers hardly enough to meet their needs.

The blended finance facility combines grants from YES BANK with the financial services provided by the local co-operative bank - making debt available and affordable to the women salt farmers. The facility also addresses the perceived high default risk posed by the farmers, owing to their current financial conditions and a lack of formal credit history, to the local lender through a credit risk guarantee.

Figure 6: Salient features of Blended Finance Facility



Outcome and Impact of the blended finance facility:

- Positive impact on Livelihoods and Health, Gender empowerment, Energy inclusion, Financial inclusion
- Annual savings of 2.7 tCO_2e (tonnes of carbon dioxide) from each solar pump

- Demonstration of social impact through a blended finance facility for development banks, multilateral organizations and donor/philanthropists

- Capital Markets: Capital market in India is emerging as an increasingly attractive avenue for raising finances for infrastructure projects in India. Realizing the potential of bond markets to increase the financing of long term investment, the Reserve Bank of India (RBI) has proposed reforms to increase investor participation, which has provided impetus to the growth of the bond market. This makes capital market another avenue for private capital infusion in FEW nexus aligned sectors and interventions through following innovative mechanisms:

    - **Green bonds:** Green bonds have established themselves as one of the key financing mechanisms for raising money from capital markets for environment friendly business activities and interventions. Since the maiden issuance of INR 1000 Crores (USD 160 billion) in 2015, the green bond market has grown steadily in India, becoming a USD 6.3 billion market by the end of 2017. Though the green bonds have been used to finance predominately renewable energy in India, such instruments holds enormous potential for other sectors. In 2017, Jain Irrigation Trading issued offshore green bonds USD 200 billion on London Stock Exchange to fund adoption of renewable energy, micro-irrigation and water efficiency measures, making it the first green bond with a primary focus on micro-irrigation. The innovation is a perfect example of how green bond proceeds can be used to raise funds for FEW nexus aligned interventions

    - **Securitization:** Most initiatives linked to FEW nexus approach, especially in agriculture sector tend to be localized, small-scale and distributed across the geography of the Indian sub-continent. These interventions vary from innovative application of drip irrigation, water harvesting infrastructure, off-grid solar systems, waste water management, which are undertaken by small scale farmers and generally have limited access to mainstream financing, owing to small ticket size and lack of credit history. Aggregating and securitizing such small scale projects backed by appropriate risk guarantees would increase their attractiveness to investors, enabling such projects to access mainstream debt

- **Portfolio management through FEW nexus approach:** Priority Sector Lending (PSL) norms by RBI has become instrumental in providing institutional credit to identified sectors and segments. With a requirement of 40% credit financing for scheduled commercial banks, agriculture forms the largest, accounting for 18% of PSL. Within the same framework of PSL, there is a need to move from food-specific targets to FEW-specific targets. PSL with a FEW perspective, holds enormous potential towards channelizing finances for scaling nexus aligned interventions

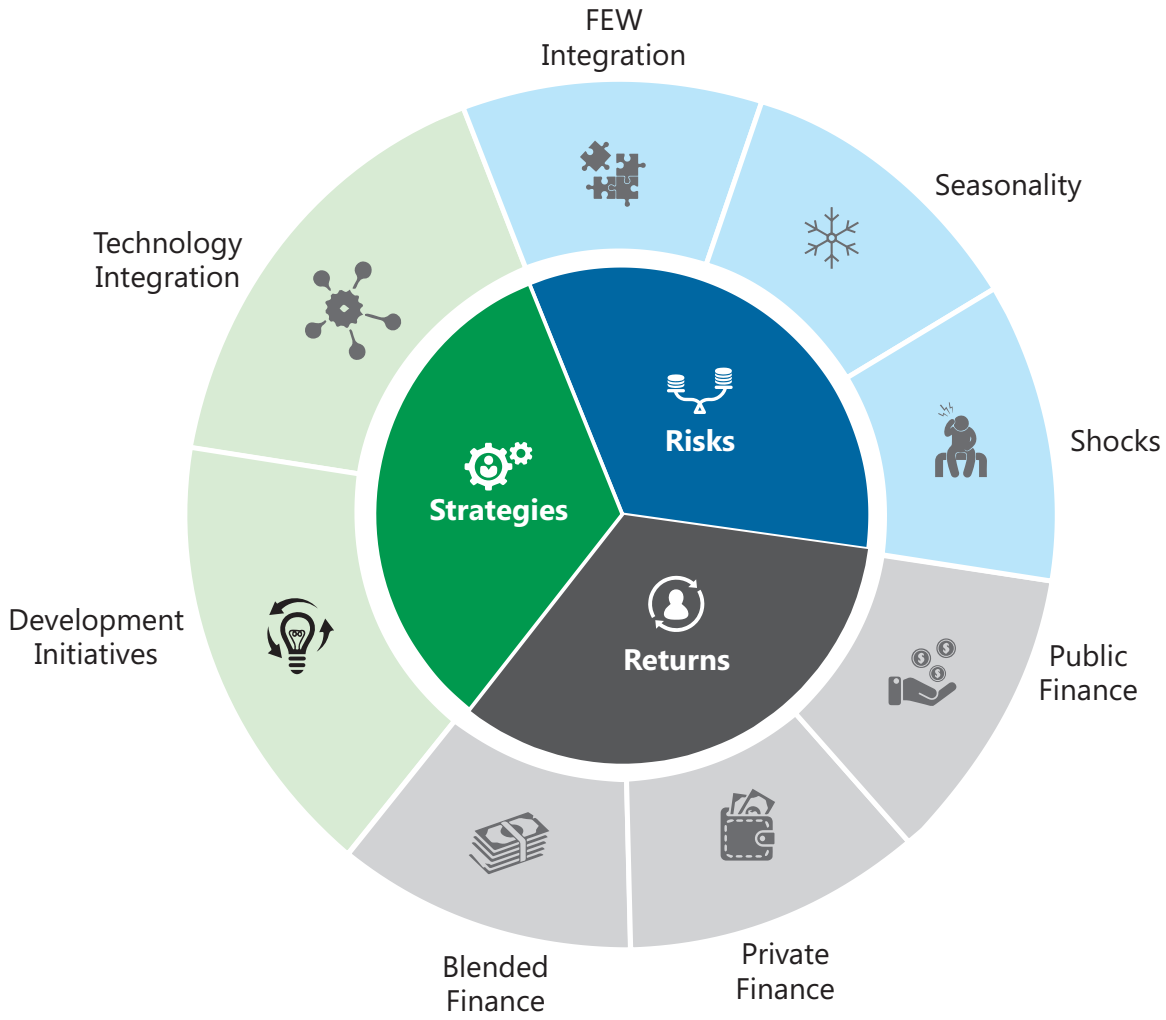
- **Corporate Social Responsibility:** Through mandating a prescribed portion of company profits towards delivering impact, the revision to the Companies Act in 2013 has led to an unprecedented rise in private participation in sustainable development. The increasing private participation is evident by the 22% rise in spending in the FY 15-16 leading to mobilization of INR 8,300 crore (Bain & Co. 2017). Corporate with strong CSR commitments can play crucial role in mainstreaming FEW nexus approach, thereby equipping communities with livelihood improvement tools. Already, India is witnessing a growing sentiment among the corporate to carry out impactful interventions, which provides an attractive outlook to CSR as a FEW nexus financing option for communities' benefit

Table 3: Examples of FEW stewardship in Corporate Social Responsibility

Corporates	CSR initiatives	Impact
Pepsico India	Partnership with Farmers: • Helping farmers improve yield and income with introduction of high yielding varieties, sustainable farming methods • Collaboration with institutes and investments for quality potato minitubers development and production	• Benefitting more than 11,000 farmers across Punjab, Maharashtra, Bihar, Karnataka, Bihar, West Bengal, UP
Coca Cola	Project Unnati in collaboration with Jain Irrigation: • Helping Mango farmers through trainings on new and high yielding technologies and encouraging them to adopt new, sustainable agriculture practices	• Target to benefit 1 lakh mango farmers country wide
JSW Group	Innovative Watershed Management: • In addition to watershed activities, assisted capacity development of communities through exposure visits, hands-on training, demonstrations, leadership skill development, and communication skills	• A total of 3,500 farmers benefitted through the training programs

An overview of the Mainstreaming FEW nexus approach for livelihoods is illustrated in the figure 7 below

Figure 7: Mainstreaming FEW nexus approach for livelihoods



Conclusion

Achieving food, energy and water security are essential in sustaining and improving livelihood opportunities in India in an equitable manner. Currently, the country faces issues regarding the availability and quality of vital natural resources and the situation is further exacerbated by global mega-trends such as climate change and population growth, affecting all the aspects of the nexus. It is evident that the traditional approach of managing each of the FEWL compartments independently is no longer a smart option and an integrated systems approach is a suitable way to provide better understanding of the interaction between the three legs of the nexus, and their corresponding impact on livelihood generation and overall long term economic growth.

Fortunately, there are clear political signals and intent to act demonstrated by public and private sector organizations, financial institutions and NGOs, who are increasingly working together to enable transition from the resource scarcity trajectory. Despite the significant progress exemplified through policy and innovative business interventions, there remains numerous challenges in actual implementation of the nexus approach.

FEWLing the growth of the nexus approach requires taking into consideration the intricate linkages and interdependencies amongst the dependent sectors by:

Framing enabling 'nexus-sensitive' policies: Food, energy, water and livelihood ecosystems are closely integrated, yet most of the strategic decision-making and policy frameworks are guided by individual assessments of the sectors. Understanding the challenges and opportunities arising out of the nexus approach and translating them into relevant policies at the local, regional and national level would help develop integrated resource management and cross-cutting governance to identify mutually synergic responses to India's developmental challenges.

Establishing innovative business models and financing mechanisms: Innovating viable, unique, scalable and sustainable solutions, with multiple positive impacts on the FEW sectors, while generating sustainable livelihoods is the need of the hour. With adequate support from the policymakers and financial sector, it is possible to transform the business landscape and innovate technological solutions to better utilize the critical resources, while sustaining the livelihoods of millions of Indians. Moreover, businesses which do not evolve with the changing paradigms and take into consideration Environment Social and Governance parameters, might run into business continuity, legal and credit risks in the long run.

In order to better equip themselves for this transition, investors and lenders need to evolve their traditional decision-making and risk management process to a more holistic one, accounting for externalities. FEW-related risks are generally systemic in nature, and do not restrict to a particular sector, thereby requiring holistic risk management and innovative financial instruments to finance risk-return adjusted projects. The report discusses in detail the potential instruments that can be deployed to mobilize funds for FEW-aligned projects.

Weighing the trade-offs and exploring synergies between the sectors: Understanding the interdependencies between the Food-Energy-Water-Livelihood resources, guided by the systemic thinking, to identify the synergies and trade-offs is the key to nexus friendly approach. This holistic approach would reduce negative externalities and increase overall resource-use efficiency, improve

productivity and promote development goals. Making informed decisions, considering the impact of one sector on the other will result in effective policy formulation and successful business models that attract the desired levels of investment and innovation.

Leveraging the power of partnerships to achieve FEWL security: There is a clear need to move away from a 'silo' approach to a more integrated one, that transcends policy making, business and technological development and financing for FEW projects. While Governments continue to play a key role in integrating the nexus approach into national strategies and policy frameworks, the task at hand requires all the stakeholders to come on board including corporate, civil society and multilateral agencies to move the needle in the right direction. The inter-linkages amongst the sectors increase the complexity, thereby requiring close coordination and co-operation among these different entities to achieve the end goal of successful integration.

The way forward would require amalgamating these critical aspects into Government and corporate strategies to accelerate transition to a more comprehensive and integrated approach to deal with FEWL aligned sectors. This report charts out a map for all such relevant stakeholders to utilize and carve a sustainable future.

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