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WITHOUT FARMERS' MENTAL SECURITY FOOD SECURITY IS A PIPE DREAM

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ABSTRACT :

Mental health of people is very important in every occupation including in agriculture. Farming is a risky occupation, its successes depends on several factors like-freshwater, fertile soil, seed, insects, weather events, geophysical disturbances and the mental health of famers is the prime factor. For most of the farmers, the only livelihood security is agriculture. Hence, the farmers are taking care of their crops as their children as the mother takes care of her child both day and night. Therefore, when crop fails farmers are unable to balance their mental agony and goes to the extent of suicides. Though this incident is happening in very few nations, it is the biggest tragedy in India, because of the water scarcity in crop season. Since 1995, the first year the government began keeping detailed records; about 300,000 farmers have taken their lives in India. The 2011 census found, that the suicide rate for farmers was 47% higher than the national average, at the rate of a farmer's suicide in every 30 minutes in this nation. Though several causes are attributed to this tragedy, the primary reason is non-availability of freshwater during crop growth. By water management paths, it is possible to generate/save additional water resources everywhere in the globe. However, India is concerned, by a single operation, sharing the excess water let into the sea from this nation, it is possible to provide water on a sustainable basis to the entire water scarcity regions of this nation and help the farmers to grow crops with uninterrupted water supply than practicing many paths. So, only by water sharing, the mental balance of an Indian farmer can be permanently kept without disturbance and sustain agricultural production and produce 450million tons for the projected population of 1.62 billion in 2050 along with livelihood security of each farmer in this nation. If India begins to share the excess water 1645 km^3 (58,092TMC), which is more than 581 times the capacity of Stanley Reservoir (about 100TMC) let into the sea almost in every monsoon season with the regions of water stress, there will be no suicide of farmers, deserting of farming in this nation as and when sharing of water is completed. The value of the water let into the sea in India in terms of paddy cultivation is more than Rs. 29 lakh crores per annum. This is the only way to arrest farmers' suicides and all water miseries in India and keep the agricultural GDP at 4% per annum. Because of non-sharing the Indian water resources, mainly Tamil Nadu is periodically affected by water scarcity in many years, and heavily in the 2016-2017 water famine. Hence, more than 95% of the people of this state are unable to get even the basic per capita per day demand of 50 litres of clean drinking water due the bad behaviour of the hydrologic cycle in the above period. So, due to drinking the contaminated water and mosquito breeding from the stagnant sewage, the dengue fever alone killed more than 80 people by mosquito bite so far in 2016-2017. The other common diseases, because of drinking the polluted water since freshwater was not available, also affected many people in this period. Therefore, Tamil Nadu is taken as a model state in this paper, and discussed the water management paths of additionally generating/saving water resources and arrest farmers' suicides by

providing sustainable water resource to the crops. By water management paths, it is possible to generate/save about 1000TMC of water in Tamil Nadu, but it will take several decades and a huge fund to achieve it. However, by sharing the excess Indian water resources, it is possible to arrest all water miseries including farmers' suicides in the entire nation by spending Rs. 12 to 15 lakh crores. Indian government could achieve this programme within 15 years by providing about one-lack core rupees in each budget. Hence, the authors of this paper suggest completing the public oriented water sharing programme gradually at least in 2050 by an "Action Plan". Therefore, without water sharing, arresting farmer's suicides in India is an illusion.

KEYWORDS : *Mental health, Farmer's livelihood security, Water management paths, Water sharing, Water policy, Food security.*

INTRODUCTION

The World Health Organization) has defined, "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." The above organization also defined, "The mental health is a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community". From the first definition, it is understood that the mental health is as important as the disease free physical health. The second definition confirms, the mental health is more important for leading a useful life as an individual and to serve both self and the community. Therefore, every human being should understand that mental health is very important to lead a normal life.

Human beings loose their mental balance due to various causes starting from the childhood. A newborn child looses its mental balance and cries for milk when it is hungry. A student dies when he/she is loosing the mental balance while unable to achieve the long aspiration of choosing the choice of an educational course. The child when attained the age of adolescence, loosing the mental balance and dies due to unable to get a job, or and chose his/her life partner. Similarly, parents in old age die when their own children do not take care of them. The famer takes his own life when his crop, the only livelihood security withering in drought. A human being beats and at time kills, another human being is nothing but loosing his/her mental balance. As we are all aware, because of the mental behaviour, each person behaves differently within a day and at time within few seconds. Hence, in the life span of each human being, because of mental health problems, his/her thinking, mood, behaviour and activities are affected. So, suicides and other inhuman activities among people in the world are taking place only by loosing the mental balance. *Therefore, mental health is important at every stage of human life, from childhood and adolescence through adulthood.* Mental imbalance is not only affecting the behaviour of human beings, animals also. An animal moving to the agricultural farm beyond its habitat in drought is also due to the mental stress of unable get water and food in its own habitat. By mistake, or wantonly some people touch, or beat snakes. Immediately, the snakes behave differently, bite people, and at times it become fatal. *Therefore, human beings and animals behave differently while they are under stress and farmer is not an exception.* Human deaths are taking place from the origin of human beings by various causes, like accidents, diseases, weather and geophysical incidents. However, the suicides of farmers is a tragic event that is high in some India states, now extended to Tamil Nadu also mainly in the unprecedented 140 years drought in 2016.

This paper brings various facts on water, land and food resources in global, Indian and Tamil Nadu level to know the availability of these natural resources and their capacity to sustain the life of the future population in these regions. As per Natarajan Dr.P.M, May 1, 2013) the natural resources land, freshwater and food to be produced with the first two, the Earth carrying capacity is likely to be 30 billion and our only living planet, the Earth reaches this limit by 2250 and 2275 AD. Therefore, we all should understand that without farmers' livelihood security, Earth could not support so much people.

Farmers' suicides are common in the Bacillus Thuringiensis (Bt) cotton (genetically modified variety) belt states in India and not common in Tamil Nadu, but this is the bigger tragedy in this state since the unprecedented 140years drought in 2016. As we are all aware, only by providing water security for

agriculture, the mental health of the farmers could be protected. Hence, this paper finds that by water management paths it could be possible to generate/save additional water resources to sustain agriculture, and thereby provide livelihood security and protect the mental health of the farmers and arrest their suicides in Tamil Nadu. Therefore, Tamil Nadu model is likely to help the water scarcity nations and basins to provide sustainable water resources to the farmers' farmland and protect their mental health and livelihood security. *Only this model could achieve the food security of the people globally, until Mother Earth revolves in the Solar System.* Therefore, it is necessary to know the prevailing global, Indian and Tamil Nadu water and food security scenario and the farmers' status to find the paths to improve these natural resources as well as to arrest the farmers' suicides by providing livelihood security to them.

MATERIALS AND METHODS

The present status of water, food grain and land resources as well as the details about famers in global, Indian and Tamil Nadu has been collected from literatures through online and libraries. The background knowledge of the authors is also helped to refine the above details. The above data have suggested that the water scarcity in the crop period is the main reason for loosing the mental balance of farmers and going to the extent of committing suicides in India and in some nations. The farmers' sudden suicides at a higher rate in Tamil Nadu in the biggest 2016 drought in 140 years, supports, that the main reason for farmers' loosing their mental balance and going to the extent of suicides is absence of water for crops. Taking Tamil Nadu as a model, the present water resources, demand in 2050 and the gap have been calculated for this state. Water management paths including sharing the excess water in India are found to be the ideal path offsetting the water shortage in Tamil Nadu. Hence, by practicing the new Tamil Nadu model, it will be possible to protect the mental health of farmers, stop farmers' suicides, sustain agriculture production globally and provide food to our future generation.

ANALYSIS

Water scarcity scenario: Around 2 billion people, or almost one-fifth of the world's population, live in areas of water scarcity. Another 1.6 billion people, or almost one quarter of the world's population, face economic water shortage (where countries lack the necessary infrastructure to take water from rivers and aquifers). By 2025, 2.8 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the world population, 3.9 billion of the 9.2 billion could be under conditions of water stress in 2050. There are 4 billion cases of diarrhoea each year, causing 2.2 million deaths (5 000 every day), mostly of children under the age of five due to consuming dirty water. One million people a year, almost all under the age of five, are killed by malaria, filariasis, schistosomiasis, intestinal worms and other water-related diseases (World Water Day, 2007) affect millions. Therefore, only by providing clean drinking water, the health of the people, including farmers can be protected.

Food shortage scenario: The world is less than 40 years away from a food shortage that will have serious implications for people and governments, according to a top scientist at the U.S. Agency for International Development. "For the first time in human history, food production will be limited on a global scale by the availability of land, water and energy," said Dr. Fred Davies, senior science advisor for the Texas A&M Agri Life Regents Professor of Horticultural Science sagency's bureau of food security. "Food issues could become as politically destabilizing by 2050 as energy issues are today" (Texas A&M Agri Life Communications, April 17, 2014). The effects of climate change on food production around the world could lead to 529,000 deaths by the year 2050, according to a grim new study (Chelsea Harvey, March 2, 2016).World hunger is on the rise: the estimated number of undernourished people increased from 777 million in 2015 to 815 million in 2016. Stunting still affects 155 million of children under the age of five years. Children under five who suffer from stunted growth is 154.8 million. Anaemia affects 33 percent of women of reproductive age globally (about 613 million women between 15 and 49 years of age). In 2016, wasting (unintended loss of weight and lean body tissue characteristic of many diseases) affected 7.7 percent of children under five years of age worldwide. About 17 million children suffered from severe wasting.

Southern Asia stands out with a high prevalence of 15.4 percent. As per the End of Childhood Report 2017, globally, 156 million children under age of five are stunted because of malnutrition, which is about a quarter of all the children in that age group. The percentage of children who are stunted in India is 39 percent (48 million), the highest after Yemen at 47 percent, Pakistan at 45 percent and the Democratic Republic of Congo at 43 percent. Global losses in economic productivity due to macronutrient and micronutrient deficiencies reach more than 2-3% of GDP (FAO, 2017). Over 20 crore Indians will sleep hungry every night. Over 25 lakh Indians die of hunger every year and hunger is the No.1 Cause of Death in India. India has 212 million undernourished people in 2006– only marginally below the 215 million estimated for 1990–92 (UN World Health Organization, 2006). But, India is home to 194.6 million undernourished people in 2015, the highest in the world, according to the annual report by the Food and Agriculture Organization of the United Nations (The Hindu, May 28, 2015).Hidden hunger is a form of under nutrition that occurs when the intake or absorption of vitamins and minerals (such as zinc, iodine, and iron) is too low to sustain good health and development. Hidden hunger afflicts more than 2 billion people globally. For the individual the effects can be devastating, particularly within the first 1,000 days of a child's life, from conception to the age of two, leading to mental impairment, poor health, low productivity, and even death. Global losses in economic productivity due to macronutrient and micronutrient deficiencies reach more than 2 to 3 percent of GDP. Already 1 billion people were going hungry globally due to the world's food crisis, and it is alarming to know a further 2 billion people will be affected in 2050. In India, agriculture got its dimension during green revolution. This introduced several new scientific methods, which increased food production several folds. Still, in India, 26 percent live below poverty line and several hundred die due to malnutrition (Students guru, 13 December 2008).

The above facts show that there is food shortage related health defects globally, and in India, it is high. Therefore, if farmers deserts agriculture this will further aggravate the food grain production and affect the food security of the people.

Farmers' strength: Over 1 billion people are employed in world agriculture, representing 1 in 3 of all workers. Globally, in 2014 roughly 520 million men and 410 million women were employed in agriculture, accounting for one third of all employed women. Agriculture is the primary employment sector in most developing countries and currently accounts for 60% of all jobs in Sub-Saharan Africa where women account for one half the sector's workforce. In sub-Saharan Africa over 60 percent of the entire workforce are involved in agriculture (UN, 2016). In South Asia, nearly 33 per cent of all employment growth since 1999 was in agriculture. At the global level, women are more active in the agricultural sector than men – some 38 per cent versus 33 per cent. Agricultural census data from Food and Agriculture Organization to estimate that there are about 525 million farms of all sizes in the world. Several other sources maintain that worldwide there are about 500 million farms smaller than 2 hectare. Agriculture plays a vital role in India's economy. About 54.6% of the population (68.25crore of the 125 crore) is engaged in agriculture and allied activities (census 2011) and it contributes 17.4% to the country's Gross Value Added [Department of Agriculture, Cooperation & Farmers' Welfare, 2015-2016].In Tamil Nadu, among the cultivators, about 1,515,978 were women constituting about 13.2 percent of the total workers. On the other hand, the total number of agricultural labourers in Tamil Nadu was 9,606,547 out of which 4,763,840 were women constituting about 41.6 percent of the total workers in agriculture in Tamil Nadu. *But, the farmers' strength is decreasing both by suicides as well as they deserting agriculture because of unsustainable farm income.*

Farmers' suicides: Farmers' suicides are not only in India but also in US, United Kingdom and Australia. In the Midwest of the U.S. suicide rates among male farmers are twice that of the general population. In Britain, farmers are taking their own lives at a rate of one a week. In India, one farmer committed suicide every 32 minutes between 1997 and 2005 (United Nations, 2007).Colorado state health officials recorded 4,012 suicides in the five years (2008 to 2012); 53 were farmers, mostly men, who shot themselves in Midwestern states of USA. Bankrupt farmers have sought government help as bankers press for payments, often triggering the suicides (Jain, Oct 22, 2012). As per the researchers According to Page & Fragar, (2002)., there were 921 farm suicides for the period 1988-97 in Australia A study by the Australian Institute for Suicide

Research and Prevention has found the rate of suicide among farm workers, including farm owners and employees aged between 15 and 65, is more than double than that of the rest of the population.

Farmers' suicides in India: The farmers' suicides in India are the largest in any country and it is a pathetic scenario. Between 1995 and 2012, the National Crime Records Bureau (NCRB) reported 284,673 farmers' suicides (male and female 240788 43885 respectively), which is 13.9% of all reported suicide deaths. From all reported farmers' suicides, 84.6% are males (Srijit Mishra, August 2014). On an average, around 15,400 farmers ended their lives each year between 1995 and 2003 in India. This number increased to more than 16,000 between 2004 and 2012. A total of 5,650 farmers have committed suicides in 2014. In Maharashtra alone nearly 60,000 farmers have ended their lives in last two decade**s**. Nationwide, the farmers' suicide rate was 16.3 per 100,000 farmers in 2011. That is a lot higher than 11.1, which is the rate for the rest of the population and slightly higher than the farmers' suicide rate of 15.8 in 2001. There is no comprehensive data on farmer suicides in Tamil Nadu in the 2016-17 farming season, but newspaper reports and independent inquiries by groups like the People's Union of Civil Liberties (PUCL) and the Tamil Nadu Federation of Women Farmers Rights suggest that over 200 farmers died of heart attacks or committed suicide in December 2016 and January 2017. The sudden spike in death rates comes mainly from the Cauvery delta region. Tamil Nadu is not like the dry and barren Marathwada or Bundelkhand or deserts of western Rajasthan – this is the highly productive Cauvery delta, a region that epitomises one of the oldest civilisations in the world, where the farmers until two decade ago grew three crops every year to meet local needs and send the surplus to feed the deficit in other regions. This is also not Vidarbha, where cotton farmers' suicides are not abating. This is *"South India's paddy bowl"* – the land of prosperity. As per the most recent FAO projection from 2005/2007, the global food demand is expected to increase 54% and to achieve this target farmers' livelihood security and their strength are very important.

Food demand: The Food and Agriculture Organization (FAO) define food security: when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life**.**

In the crop year 2015-2016, a total of approximately 2.4 billion metric tons of grain were produced worldwide. The most important grain was corn, based on a production amount of about 1.05 billion metric tons in 2016-2017. Global demand for major grains, such as maize, rice, and wheat, is projected to increase by nearly 48 percent from 2000-2025 and by 70 percent between 2000 and 2050. Demand for food is likely to increase by 70 percent between now and 2050, equaling twice the amount of additional food that is currently available to consumers (The Statistics Portal, 2017). World food production, which increased by 1,225 million tonnes between 1961-63 and 2005-2007, is projected to reach 3 billion tonnes by 2050 (Alexandratos et al., 2012). As per the High Level Expert Forum, (12-13 October 2009), the demand for cereals, for both food and animal feed uses is projected to reach some 3 billion tonnes by 2050, up from today's nearly 2.1 billion tonnes. David Nabarro, Coordinator of the High-level Task Force of the Secretary-General on the Global Food Security Crisis, said that the amount of money needed to address the food challenge was estimated between $25 billion and $40 billion per year. Assuming that GDP grows by 8 percent for the next 20 years in India, the total cereal demand projected for 2026 is 274 million tonnes. In India, the food grain production in the 2015-16 crop year was 252.23 million tonnes and the food demand in 2050 for the projected population of 1.62 billion is 450million tons. Therefore, in 2050 we need to produce about 3 billion tons food grain globally, for India 450million tons and for Tamil Nadu 170lakh tons. To achieve this target we need freshwater, fertile land and farmers' support. Therefore, we must know, whether there are enough land and water resources and the present status of farmers capable of to produce enough food for our future generation.

Water demand: Global demand for water has risen sharply over the last century. Total annual water withdrawal from agriculture, municipalities and industries rose from less than 580 km^3 in 1900 to more than 3 900 km^3 in 2010. Agriculture accounts for approximately 70 percent of total freshwater withdrawal in the world, mostly through irrigation (FAO, 2015). As per Helen Mount ford, Deputy Director, OECD Environment Directorate, 2011, the Global freshwater demand in 2050 for domestic, irrigation, industry, livestock and

electricity is 5500km^3. But, the global freshwater resource is 40000 km^3 to 43000 km^3. Hence, there is enough freshwater resource in the future. The global per capita annual water resource is decreasing due to the increasing population. Demand for freshwater is increasing by 64 km^3 a year. World freshwater resource in 2002: 6998.726 m^3, 2007: 6570.297 m^3, 2012: 6060.016 m^3 and 2014: 5922.428 m^3.

As per the World Data Atlas, the present water storage in India is 224 km^3 but the available surface water resource as per the Indian Water Resources Society is 1869 km^3 and hence there is enough water for future use. Even in 2050 only about 450 km^3 is likely to be harvested and hence there will be a flow about 1419 km^3 flood water into the sea at that point of time. In India, the per capita annual water resource in 1947 was about 5000 m^3, in 2010:1588 m^3 and in 2025: 1500 m^3/year or 30% of availability levels at Independence. In Tamil Nadu in the 1643 TMC of water more than 95 % is already used and hence the remaining is uncertain to sustain the water demand of this state in future. The gap in 2016 was: 1064 TMC and in 2050 the gap will be 2,056TMC at the per capita annual demand of 1000m^3.

Land demand: Globally More than 1.6 billion hectares – about 12 percent of the world's land area are used for crop production. There may remain some 1.3 billion ha free but usable land in 2050 in the world (Nikos Alexandratos et al., 2012).The total irrigation potential of major and medium projects in India increased to 102.8 million hectares in 2006-07. The ultimate irrigation potential in India is 139.89 million hectares and hence there is balance irrigation potential for future agricultural operation in this nation (Natasha Kwat). In Tamil Nadu, in the net sown area of 56 lakh hectares, about 30 lakh hectares (54 per cent) of arable land are irrigated. The current and other follow land in Tamil Nadu is 17.6lakh hectare. This land can be used for future irrigation (Jothi Sivagnanam, Dr. K , 2011).

Food security with farmers' livelihood security: From the above discussion, it can be seen that there is enough land and water resources globally and in India for sustainable agricultural operation. Though there is land in Tamil Nadu to generate additional irrigation potential, there is a huge water supply demand gap presently at 1064TMC and 2056TMC in 2050.Globally and in India, there are enough water resources. However, there are physical water scarcities nations in the world and in India there are states like Tamil Nadu with absolute water scarcity. The 200 farmers' suicides in the 2016-2017 water famine years, more than 80 dengue fever deaths and many water borne diseases because of drinking the contaminated water in the absence of clean water in this year would have been averted if the excess Indian water resources was shared. In these water scarcity regions and in Tamil Nadu, which is periodically affected by drought, only through water management paths, it will be possible to improve the water resources and sustain agricultural production. Therefore, for the sustainable livelihood security of farmers it is necessary to provide uninterrupted water supply to crops, then only the farmers can produce 3 billion tons of food grain globally for the future projected population of about 9.3 billion in 2050.

Physical water scarcity in Tamil Nadu: With the geographical area of 130,058km^2, Tamil Nadu covers 4% of the total area of India,7% of population, only with 3% of water resources and with 64% area drought prone. In India, next to Rajasthan, Tamil Nadu is facing physical water scarcity. In the 140 years unprecedented drought in 2016, there was no clean drinking water for about 95% of the people due to the 81% deficit rainfall in this year and this is the reason for the farmer's suicides and dengue fever along with other water borne diseases in this state in 2016-2017. To arrest the water scarcity, it is necessary to assess the water resources status, demand and the gap to find out the strategies to improve the water resources of this state.

Tamil Nadu water resources status: The average annual water resources of Tamil Nadu is 1643 thousand million cubic feet (TMC), surface water 853TMC and groundwater 790TMC, and the present per capita annul water resource is 641 m^3 (water deficit 1059m^3, 62%), and in 2050 it will dwindle to 416 m^3 (water deficit 1284 m^3, 75.53%). As per the Falkenmark Water Stress Indicator norm, for the healthy life of a person, per annum per capita water demand is 1700m^3. If it drops below 500m^3, there is absolute water scarcity/water famine and hence Tamil Nadu has been reeling under water famine in many years. In 2016 there was four times absolute water scarcity in Tamil Nadu, since the per capita water resource was only 122m^3, the lowest in the previous 140 years, because of the 81% deficit rainfall. ***If the water resource of Tamil Nadu state is not improved, it would be difficult to produce food grain and provide even one meal in a day to the people***

of this state in 2050 with the available water resources at that point of time. In the present context of absolute water scarcity in some states in India, only by water management pathways, it could be possible to arrest the situation. ***However, permanently to arrest the water scarcity in these states, sharing the Indian excess water let into the sea is need of the hour.*** Since Tamil Nadu state has adequate seacoast in the east and south, desalination of seawater is also possible. However, due to the heavy investment, it is not advisable to practice this technology now to bridge the entire water demand of this state, except using it for domestic uses. Since the monsoon rain in Tamil Nadu is not dependable, it is better to harvest the occasional floods within this state and reserve it for the future use. This approach can generate appreciable groundwater recharge, arrest the depletion and seawater intrusion in the coastal aquifers.

Water management paths to generate/save additional water resources in Tamil Nadu: By adopting nine water management paths without sharing the excess Indian water resources, it could be impossible to improve/save not more than 1000TMC in this state and hence unable to provide per capita annul water resource at 1700m^3 and 1000 m^3 as per the world water norm-Table 1. It will take one or two decades to complete the water management paths to generate the above inadequate quantity, and huge fund is necessary to practice them successfully. Even by practicing these approaches, the per capita water resource in 2050 can be improved to only 684 m^3 from the 416m^3 and not 1700m^3/1000 m^3 to bring it to the Falkenmark Water Stress Indicator norm and hence, the per capita water deficit in this state in 2050 will be 1016m^3 (59.76%) even after practicing water management paths. ***Hence, to improve the per capita annual water resources to 1700m^3 or 1000m^3, not only in Tamil Nadu but also in all water stressed Indian states, sharing the excess Indian water is the ideal and best option.*** However, in the states located in the east, south and west seacoasts in India, it is possible to sustain water resources development by desalination if fund is available.

Paths to sustain permanent water resources development in Tamil Nadu: As of Tamil Nadu is concerned, by two paths 1. Desalination of seawater (if sufficient fund is available) and 2. In addition to the nine paths already suggested, sharing the excess Indian water resources let into the sea could help to improve water resources of this state permanently.

Desalination of seawater to sustain water resources development: Since Tamil Nadu state has 1076 km length of seacoast, it is possible to sustain water resources development by desalination of seawater. However, this technology is suitable mainly for supplying drinking water and not for agriculture and industry, since the cost of this technology is high to meet the huge water demand, other than domestic use.

To bridge the 2056 TMC water supply demand gap in Tamil Nadu in 2050 by desalination, the cost will be more than Rs. 58 lakh crores (Capital, maintenance and water distribution).To bridge the water supply demand gap at 399 TMC in the above period, for Cauvery delta, the cost will be more than Rs.12 lakh crores by the above approach in 2050 (Calculated based on the experience of a 190 million liters per day (MLD) capacity desalination plant in Carlsbad, San Diego, California state, USA).

However, by investing about Rs. 12 to 15 lakh crores, the Indian nation could provide uninterrupted water supply for domestic, agriculture and industrial uses and arrest all water miseries everywhere in India by sharing the excess Indian floodwater let into the sea in the normal monsoon years. This vital approach is still eluding India even after 70 years of Independence. This is the reason for more than 3 lakh farmers' suicides in India from 1995-2014 and presently about 200 farmers' suicides in 2016-17 in Tamil Nadu also, and waiving of farm loan worth of several crores of rupees to the farmers of Tamil Nadu, Karnataka, Madhya Pradesh, Punjab, Utter Pradesh and Maharashtra.

Table - 1: Quantity of water to be generated/ saved by water security pathways in Tamil Nadu	
Water security pathways	Quantity of water in TMC
Flood and rainwater harvesting	155
Artificial groundwater recharge	375
Treating and recycling domestic wastewater	100
Water saving in agricultural sector	352
Desalination of seawater	30
Arresting seawater intrusion	2
Virtual water trade	20
Improving irrigation efficiency	50
Rejuvenation of water bodies	50
Total	1,113.2 or 1,000TMC/28.32km^3

Water sharing the permanent option to arrest the water scarcity in India: Even today, a huge quantity of floodwater is let into the sea in India. In 2050, about 26 times of Tamil Nadu water supply demand gap (1503km^3/53,078TMC) will flow to the sea from the surplus Indian rivers. In the east flowing south Indian Mahanadhi, Godavari, Krishna and Pennar rivers, about twice (4301TMC) the water supply demand gap of the Tamil Nadu will flow into the sea at the annual per capita demand at 1000 m^3 in the above year. Hence, there is enough water resource in the national level as well as in the east flowing south Indian rivers also, that can be shared easily with Tamil Nadu (Natarajan, et al, (2017) and **Natarajan**,Natarajan, 2017).

Artificial groundwater recharge to compensate the rainfall departure: The monsoon rainfall is not dependable in Tamil Nadu due to the periodical rainfall departure, and hence the water resource is decreasing in such rainfall deviation years and it is high in 2016 due to the 81% rainfall deficit. The total change in groundwater storage across the state of Tamil Nadu over a period of 11 years, because of the rainfall departure, from 2002 to 2012 has been assessed by the nonconventional remote sensing based technology, the NASA's Gravity Recovery and Climate Experiment and the Global Land Data Assimilation Systems. The results show, groundwater depletion at the rate of 21.4km^3/755.73 TMC per year, which is 8% more than the annual recharge rate (19.81km^3/699.58 TMC per year) owing to the total rainfall of 1016 mm year. Maximum depletion was observed in 2008, while the least depletion was observed in 2002 with rates of 41.15 cm and 0.32 cm per year, respectively. Districts such as Dharmapuri, Vellore and Thiruvannamali encountered intense groundwater depletion. The year of 2016 has faced the worst rainfall deficit in last 140 years in Tamil Nadu, with 62% deficit in the northeast monsoon and 19% deficit in the southwest monsoon, and the total deficit for the two seasons was 81% (Waghmare, 2017). This is the main reason for the heavy deviation of rainfall and abnormal groundwater depletion almost in all areas in Tamil Nadu. From 2012 to 20016, 2015 is the good monsoon year, and the remaining three years have not received the normal 925mm rainfall. Considering the least depletion of water level as 41.15cm in 2002, the cumulative groundwater depletion has been calculated as 123.45cm (over 4feet) for three years and for this depletion in hard rock and in sedimentary regions with specific yield at 5% and 15% respectively, the cumulative depletion of groundwater is assessed as 289TMC. Since the abnormal deviation of rainfall was 749.25mm or 81% in 2016 comparing the normal rainfall 925mm, to compensate the surface water loss in this year there might be an additional groundwater depletion of 100TMC in this year in Tamil Nadu due to the huge groundwater pumping. So, the total depletion of groundwater in four years from 2013-16 could be 389TMC.

There was already groundwater depletion at 755.73TMC as per NASA study from 2002 -2012. Hence, the total depletion was likely to be around 1143TMC from 2002 to 2016, about 353 TMC above the normal groundwater recharge of this state (790TMC), which works out to 46% over and above the normal recharge due to the cumulative groundwater depletion of 576cm, over 19 feet, from 2002 – 2016. This is the main

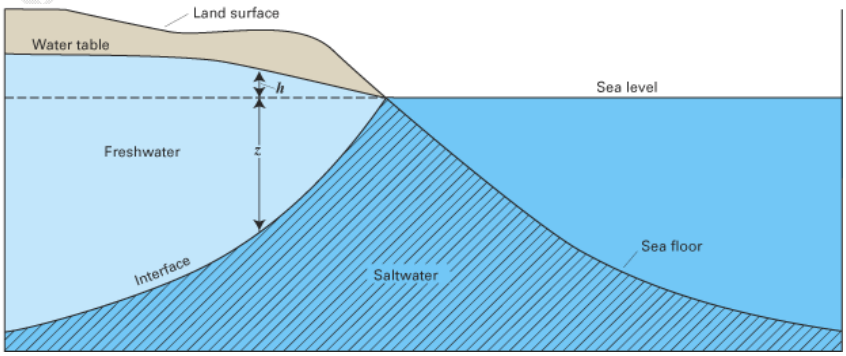
reason for the present huge water scarcity in Tamil Nadu in 2016-2017. Hence, artificial groundwater recharge practices are need of the hour everywhere in Tamil Nadu to recover the depletion of groundwater. Due to over abstraction of groundwater, the present Stage of Ground Water Development has reached to 85% in Tamil Nadu. In the total 386 Blocks in Tamil Nadu, there are 139 Over Exploited Blocks, 33 Critical Blocks and 67 Semi-critical Bocks, Saline Blocks 11 and the Safe Blocks fit for groundwater development are only136. Unless groundwater laws are practiced along with improving the recharge, the safe blocks will decrease and all area will be over developed shortly. In the present context of depletion of groundwater level, all the aquifers are to be protected as groundwater sanctuaries and recharged periodically by practicing spot specific recharge techniques-Table 2 (Natarajan, and Shambhu Kallolikar, 2004).

Table – 2: Artificial groundwater recharge techniques

1. Spreading methods	12. Collector well
a. Basin b. Ditch or	13. Infiltration
c. Furrow d. Channel	14. Bore blast
e. Flooding f. Irrigation	15. Hydro fracturing
2.Pit method	16. Fracture sealing and cementation
3. Induced recharge	17. Contour trench
4. Recharge well	18. Contour bund
5. Sub-surface dyke	19. Gully plug
6. Percolation pond	20. Leveling
7. Check dam	21. Terracing
8. Nala bunds	22. Recharge shaft
9. Stream channel modification	23. Injection well
10. Gravity head recharge well	24.Combination methods of artificial groundwater recharge
11. Connector well	13. Infiltration

The two hydrologists, Ghyben and Herzberg studied the groundwater condition in the coastal area of the Europe and found that the seawater is below 40 times of the fresh groundwater column/thickness of the coastal aquifer below mean sea level-Figure 1. Due to the density variations of the sea and ground waters, the above hydrological situation occurs in the coastal area aquifers. This relationship is mathematically explained below with the help of a seawater and groundwater model (Hilton H. Cooper, JR et al., 1964).

Figure – 1: Ghyben Herzberg relation



The figure shows the Ghyben-Herzberg relation. In the equation,

$$z = \frac{\rho_f}{(\rho_s - \rho_f)} h$$

The thickness of the freshwater zone above sea level is represented as *h* and that below sea level is represented as *z*. The two thicknesses *h* and *z*, are related by ρ_f and ρ_s where ρ_f is the density of freshwater and ρ_s is the density of saltwater. Freshwater has a density of about 1.000 grams per cubic centimeter (g/cm^3) at 20 °C, whereas that of seawater is about 1.025 g/cm^3. The equation can be simplified to

$$z = 40h.$$

Therefore, by developing the groundwater in such a way by keeping one-foot fresh groundwater above mean sea level it is possible to arrest the seawater intrusion in the coastal aquifers of the Chennai City and in the entire 1076km length of the Tamil Nadu coast.

Standby freshwater water demand to meet the water stress in drought years: In the drought years, every country needs to have the basic per capita per day demand of 50 litres of clean water by a dependable source. This may be desalination or, treating and recycling the wastewater to the advanced stage of drinking (people in Singapore, Australia and Namibia, and states such as California, Virginia and New Mexico of USA are drinking the treated wastewater to the advanced stage), or any dependable source in drought years. The basic annual water demand at 50 lpcd for the projected 104.75million Tamil Nadu people in 2050 will be 67.51TMC, and per day demand of water for this use is 5237.50million litre (MLD) or 5.24 million cubic metre (MCM). Tamil Nadu needs $30billion and $ 510 million respectively for the capital and maintenance cost of 30 plants, each at one billion and 17million US dollars per desalination plant respectively and each with a capacity at 190MLD (Calculated based on the desalination plant in Carlsbad, San Diego, USA). *Therefore, a standby source of desalinated water is necessary to meet the basic demand of water in Tamil Nadu in the drought years.*

The Indian National Water Policy should aim at providing sustainable water resources to all sectors, prioritizing in the order- domestic, agriculture, ecology, industry, energy, navigation by an ***"Action Plan"*** at least in the 75 years Indian Independence Day in 2022 or in 2050**.** Each nation has to prioritize their sectors of water use by a suitable *water policy*. If water sharing had been implemented in India, Tamil Nadu need not be suffering by both dengue and water miseries in 2016-2017.Water scarcity the main cause for farmers' suicides: The main causes attributed for the farmers' suicides in India are: absence of assured irrigation facilities; absence of adequate social support infrastructure at the level of the village and district level; uncertainty of agricultural enterprise; indebtedness of farmers; rising costs of cultivation; plummeting prices of farm commodities; lack of micro credit facility for small farmers; repeated crop failures; crop diseases, mounting debts; droughts; well failures; lack of support price for the farm produce; middlemen and delay in getting the institutional finance at time of farm operation. If we provide all facilities to farmers to overcome the above problems except water, the farmers would not earn sustainable farm income, because the main input for crops is water and other inputs are seed and manure. Therefore, the major cause of suicides of farmers is the non-availability of water in the different stages of crop**.** *Even after 70 years of independence, the Indian government is not providing the basic demand of water for drinking. This is the biggest tragedy.* Since farmers' only livelihood security is agriculture, by providing the basic resource of water and other supports like compensation for crop loss because of weather events, crop diseases and geophysical tragedy, it could be possible to provide sustainable livelihood security to farmers and arrest farmers' suicides not only in India and in other countries also. *When farmers face water scarcity to crops, their mental balance is affected and when the crop fails, they are unable to control their mental stress and go to the extent of suicides. Hence, only by water security to the crops the livelihood security of the farmers can be protected. Therefore, without livelihood security to farmers no nation would achieve food security and economic*

growth. If the government provides permanent livelihood security to farmers, they need not go to the extent of suicides and desert farming as it is happening in India since more than two decades. *Therefore, only water security could provide mental security to farmers.*

Future agriculture operation is under threat in India: The 2000 census shows that 55% of the population of India was farming, against to 60% in 1990.As per the latest Census data as reported by P.Sainath there are nearly 15 million farmers less than there were in 1991 and over 7.7 million less since 2001. Hence, on average, that about 2,035 farmers losing every single day for the last 20 years. NGO Lokniti, Centre for the Study of Developing Societies (CSDS) conducted a study and prepared the report "State of Indian Farmers: A Report", and it discusses on the conditions of the farmer's across India to gain a nuanced insight into their socio-economic conditions. The survey was carried out between December 2013 and January 2014, in 274 villages spread over 137 districts of 18 Indian states in 5,000 farmer households. This survey said 76 per cent of farmers would prefer to do other work, while 60 per cent wanted their children to migrate and settle in a city. These are a grim reminder of the condition of the 120-million farmer households in India (Sanjeeb Mukherjee, March 12, 2014).In global level, employment in the agriculture sector dropped from just over one billion people in 2000 to 930 million in 2014, accounting for just under 30% (UN, 2016).In an agricultural income based India, with the decreasing strength of famers, it may not be possible to produce the anticipated food grain of 450 million tons to the projected 1.62 billion people in 2050. Similarly, with the existing water scarcity scenario in some nations in the world, it is likely many farmers are likely to desert agriculture and it may be difficult to produce 3 billion tons of food grain to the global 9.3 billion people in 2050.The GDP from agriculture in India averaged Rs. 3977.81Billion from 2011 until 2017, reaching an all time high of Rs.5468.54 Billion in the fourth quarter of 2016 (United States Department of Agriculture, 2014). If 76% of farmers in India desert agriculture in future, what will be the fate of Indian food rain production?.India exported $38 billion worth of agricultural products in 2013, making it the seventh largest agricultural exporter worldwide and the sixth largest net exporter. Around 60–70%% of Indian population (directly or indirectly) depends upon Agriculture sector. Agriculture GDP in India is 4.1 per cent, which is equal to Rs 1.11 trillion (US$ 1,640 billion) [United States Department of Agriculture, 2014].Food demand measured by population growth nearly doubled from 1966 to the present. It is projected to increase another 39 percent by 2050. Therefore, food demand will grow more than population growth (Babcock, 2015). In the present context of increasing demand for food for the growing global population at 83million per annum, the farmers' livelihood security and proceeding farm operation without suicides and deserting are very important to sustain agriculture and food production. The government of India targets to increase the average income of a farmer household at current prices to Rs 219,724 (US$ 3,420.21) by 2022-23 from Rs 96,703 (US$ 1,505.27) in 2015-16. *Without sharing the Indian excess water, it may not be possible to improve uniformly both the national agricultural GDP and the farmers' income in the entire nation.* Comparing the professionals, the famers are getting poor respect from the public though they are the food providers not only to human beings but also to livestock at the rate of 660 million tones of cereals (FAO, 2002) globally per year and they indirectly provide food for each insect and bird. *We should all keep it in our mind that we are all the descendants of farmers. Though some of us now occupied new professions, however, we are all eating food only by the hard work and grace of farmers. Hence, we should respect farmers and protect their livelihood security to sustain the food security of the people, now and in future.*

CONCLUSION

The only livelihood security to farmers is agriculture. Hence, when crops fail, farmers loose their mental balance and commit suicide. Therefore, immediate action is necessary to provide uninterrupted water supply to the farms in the entire crop season by generating additional water resource by water management paths. In case of water is not shared as in India, immediate action is necessary to share and supply to the farms. When crop fails due to insects, weather related and geophysical havocs, adequate compensation should be provided to farmers. In the drought years, a standby basic per capita per day demand of 50 litre is necessary by a sustainable source, globally. There is hunger, malnutrition, stunted

growth, anemia and eating less calorie value food in many nations- all are connected with food scarcity. In India, large numbers of people are suffering by these defects. Further, there is physical, economic and absolute water scarcity in many nations and there is water stress within a nation as Tamil Nadu in India. As per the High Level Expert Forum, the current projections suggest that average daily energy availability could reach 3050 kilocalorie (kcal) per person by 2050 (2970 kcal in the developing countries), up from 2770 kcal in 2003/05. Therefore, unless governments make sure access to food by the needy and vulnerable is significantly improved, and while the prevalence of chronic undernourishment in developing countries could fall from 16.3 percent (823 million) in 2003/05 to 4.8 percent in 2050, this would still mean that some 370 million persons would be undernourished in 2050. As per the Statistics Portal, 2017, the global demand for major grains, such as maize, rice, and wheat, is projected to increase by nearly 48 percent from 2000-2025 and by 70 percent between 2000 and 2050. In agriculture-based countries, it generates on average 29 percent of the gross domestic product (GDP) and employs 65 percent of the labor force. In such a scenario, if we allow farmers suicides in India, Tamil Nadu and in few nations, it will further affect the people by food related defects and hence it may not be possible to stop undernourished people in future. Further, the agricultural GDP will also fall. The farmers' suicides can be stopped only by providing uninterrupted water supply to crops in the crop period by sharing and water management paths. Therefore, only with farmers' mental health it will be possible to produce 3billion tons of food grain globally, 450million tons in India and 170 lakh tons in Tamil Nadu in 2050 for the projected population of 9.3 billion, 1.62 billion and 104.75 million to the global, Indian and Tamil Nadu population respectively at this point of time. As per the IIT, Roorkee Researches, 2017, over nine years to March 2017, the central and state governments waived Rs. 88,988 crore ($13.9 billion) in loans to 48.6 million farmers. The nationwide Rs. 52,000 crore ($11.3 billion at Rs. 45.99 per dollar) loan-waiver announced by the United Progressive Alliance (UPA) in 2008 occupies the bulk of this figure. India now faces $49.1 billion farm-loan waivers due to the drought in 2016-16 times the 2017 budget for rural roads. If adequate water is supplied to agriculture, there will be no farmers' suicides, India need not meet the present situation like waiving farm loan in future, and above all, there will be sustainable food grain production. *Therefore, without arresting farmers' suicides, achieving food security is nothing but a daydream.*

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