Food Biology 2011, 1/1:22-28
ISSN: 2249-4790
Available Online: http://foodbiology.org/

http://foodbiology.org/

Water resource conservation: Need for sustainable food crop production

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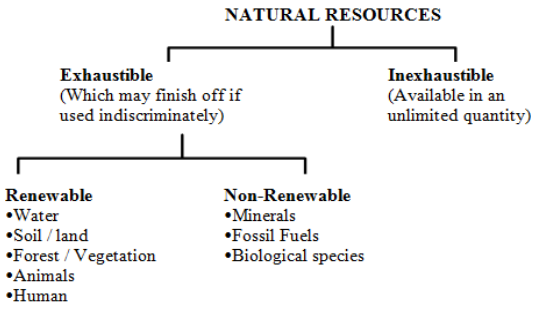
Abstract:
India is extremely rich in water resources. The country is endowed with large network of great rivers and vast alluvial basins to hold ground water. By virtue of its peculiar placement in the foothills of the magnify Himalayas and having the ranges of ***Sathpoora, Aravali*** and the decade plateau running through it the country has huge water resources which have been meagerly tapped. Over water resources can be divided into two broad categories viz., the surface water resources and the ground water resources. Each of these is a part of the earth's water circulatory; system called the hydrologic scale and each is ultimately derived from precipitation i.e., rainfall and snow. A part of the annual rainfall is held up in the undulating land surface and seeps down beneath it to give subsoil water resources. The amount which thus does not seep down flows in the form of streams and unions, the river system, another part which evaporates, forms moisture in the atmosphere which may another clouds, rain and snow. Thus all forms of water resources are inter dependent as the loss of one may be the gain of the other.

Keywords: River system, Rain, Evaporation, Water resources

INTRODUCTION

Agriculture accounting for 25 percent of the Nation's gross domestic products continues to be the ministry of the economy. Having achieved laudable success in agricultural production in the last 50 years has transformed herself from a food deficit to a food surplus country. Still there are many challenges, which Indian agriculture is facing in the fast changing market economy [9]. Relating to the national resource and production base water has emerged as a most crucial factor for sustaining the agricultural sector in the coming years [8]. India account for 16 percent of the world's human population and nearly 30 percent of the cattle with only 2.4 percent of the land area and 4 percent of water resources, even if the full irrigation potential is exploited, about 50 percent of the country's cultivated area will remain un irrigated particularly with current level of irrigation efficiency [1].

The availability of water per person per year in about 2200 m^3 for India and about 800 m^3 for southern states. The share of water for agriculture would reduce further with increasing demand from other sectors.



Renewable natural resources

Resources that have the inherent capacity to replenish themselves or reappear by quick recovery like recycling, reproducing and replacement within a reasonable time and maintain themselves, e.g. Soil, water, living organisms ext. Renewable natural resources mostly are of biotic nature.

Non-Renewable natural resources

They lack the ability for recyclization and replacement. Resources like biological species which evolved millions of years ago, became extinct and cannot be recreated now. Similarly minerals and fossilized fuels like coal and petroleum oil once extracted cannot be regenerated the same site [2].

Increasing demand of water resources

But the demand for water for agricultural purpose is estimated to increasing to produce increasing quantities of food, horticultural produce and raw material for the industry [10]. The requirement of water by different sectors by 2025 is estimated to be 105 m.ha. But the share of water for agriculture is expected to reduce from the present level of 85

Received: June 11, 2011; Revised July 28, 2011; Accepted July 28, 2011.

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percent to 71 percent by 2025. On the other hand, the demand for agricultural purposes is estimated to increase from 50 m.ha.m. in 1985 to 70 m.ha.m in 2050. during the same period, the demand for water for non agricultural use will multiply four fold from 7 m.ha.m to 28 m.ha.m [3].

RESOURCES AND DEMAND

India's water resources are substantial. The average annual rainfall is about 1150 mm. but it is an evenly distributed from 100 mm in Rajasthan to 11,000 in Chitcpunji – erratic and fails. Further the entire rainfalls within a period of 4 months. If the total rainfall is distributed evenly throughout the year as in the case of Europe, water scarcity; will next be there. The total surface of 1000 is about 195 m.ha.m of which 69 m.ha.m (35 percent) is the utilizable water. The available ground water for irrigation is about 36.0 m.ha.m of which about 11.5 m.ha.m. The total storage available in the country is about 18 m.ha.m even if all the structures under construction and contemplated in all coming years are completed the total capacity will be only about 37.50 m.ha.m [5].

The water demand for irrigation depends upon the requirements of food grains as well as non food grains. It is expected that the population of India will stabilize by 2050 and the U.N. agencies have put the figure as 1640 million. The national commission on integrated water resources development has assessed that about 450 million tones of food grains will be required by the year 2050, in 2050, the irrigation to gross cropped area about 50 percent [7].

The productivity in rain fed and irrigated area will be 1.5 tonne / hectare and 4.0 tonnes per hectare respectively. This scenario can be changed by adopting water management practices in surface irrigation methods and introducing drip and sprinkler irrigation as recommended by the task force, the potential for coverage under drip and sprinkler irrigation is estimated to be about 27 million hectares 42.5 million hectare respectively [4].

Present Scenario

The productivity per unit area of almost all crops especially the main crops like paddy, cotton, pulses are for below world average and the wheat yield is just equal to the world average. Many irrigation projects in the states of Bihar, Gujarat, Madhya Pradesh and Orissa have yet to achieve even 50 percent of the irrigation potential [11]. The irrigation development taken up during the plan period has created problems concerning drainage lag in potential created and utilized low irrigation efficiencies and the rise. The failures are due to lack of management and coordination of different department at various losses during conveyance and distribution, inequitable and untimely delivery of water to the fields.

The average efficiencies obtained are about 35 to 40 percent in irrigated land is about 1.5 to 4.0 tones / hectares for cereal crops averaging about 2.5 tonnes / hectare as compared to an achievable target of more than 5 tonnes / hectare because of inefficiency in management and improper operation of irrigation system [12].

Through Participatory Irrigation Management (PIM) is acceptation principle by all government but in practices it is not followed seriously except in a few states.

Table – 1: Productivity of Paddy in Various Countries

Sl. No.	Country	Yield (kg /hectare)
1	Egypt	9840
2	USA	7990
3	Spain	7410
4	Morocco	7350
5	India	3120
6	World	4037

Source: Agricultural Statistics at a Glance, 2010.

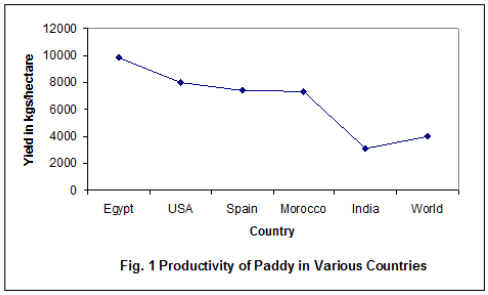

Fig. 1 Productivity of Paddy in Various Countries

Table – 2: Productivity of Majority Wheat in Various Countries

Sl. No.	Country	Yield (kg /hectare)
1	Belgium	8980
2	Netherlands	8910
3	United Kingdom	7780
4	France	7580
5	India	2713
6	World	2914

Source: Agricultural Statistics at a Glance, 2010.

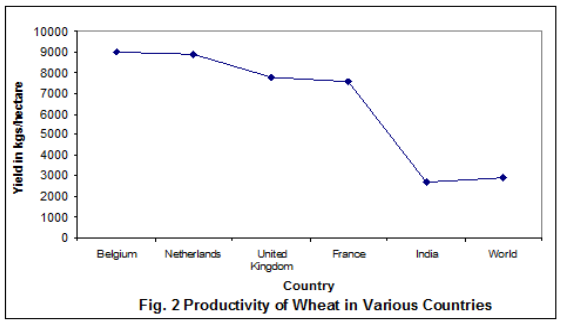

Fig. 2 Productivity of Wheat in Various Countries

Table – 3: Productivity of Majority Maize in Various Countries

Sl. No.	Country	Yield (kg /hectare)
1	Jordan	18730
2	Belgium	12820
3	Nether Lands	11820
4	New Zealand	11330
5	India	2041
6	World	1920

Source: Agricultural Statistics at a Glance, 2010.

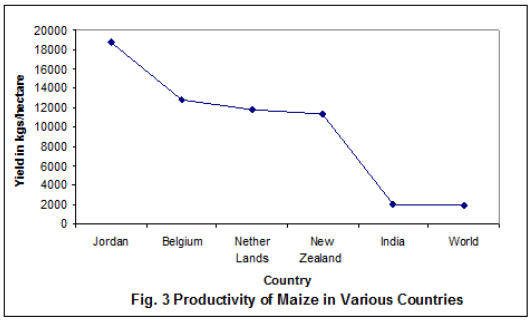

Fig. 3 Productivity of Maize in Various Countries

Table – 4: Productivity of Majority Cereals in Various Countries

Sl. No.	Country	Yield (kg /hectare)
1	Belgium	9184
2	Nether Land	8438
3	New Zealand	7583
4	Egypt	7556
5	India	2427
6	World	3348

Source: Agricultural Statistics at a Glance, 2010.

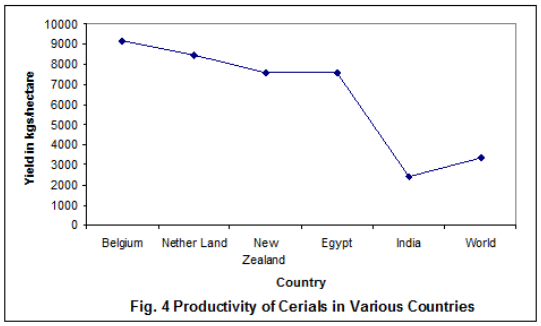

Fig. 4 Productivity of Cerials in Various Countries

Table – 5: Productivity of Majority Pulses in Various Countries

Sl. No.	Country	Yield (kg /hectare)
1	Nether Lands	4613
2	France	4543
3	Germany	3840
4	Belgium	3642
5	India	661
6	World	864

Source: Agricultural Statistics at a Glance, 2010.

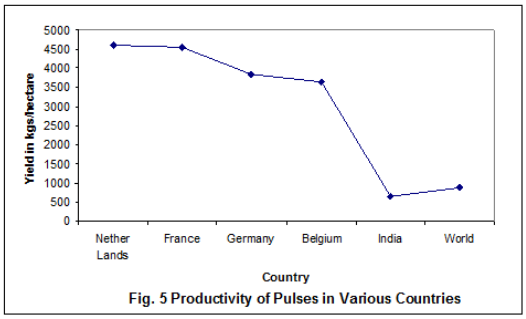

Fig. 5 Productivity of Pulses in Various Countries

Table – 6: World Comparison of Crop Productivity in India

Crop	Productivity in India (kg /hectare)	World Average Productivity (kg /hectare)	Rank in global level
Paddy	3008	3895	51
Wheat	2777	2698	32
Pulse	608	4769	118
Cotton	347	600	67
Maize	1408	18638	105

Source: Agricultural Statistics at a Glance, 2010.

World

1. Paddy = $\frac{3895}{30600}$ x 360 = 46°
2. Wheat = $\frac{3698}{30600}$ x 360 = 32°
3. Pulse = $\frac{4769}{30600}$ x 360 = 56°
4. Cotton = $\frac{600}{30600}$ x 360 = 7°
5. Maize = $\frac{18638}{30600}$ x 360 = 219°

India

1. Paddy = $\frac{3008}{8148}$ x 360 = 133°
2. Wheat = $\frac{2777}{8148}$ x 360 = 123°
3. Pulse = $\frac{608}{8148}$ x 360 = 27°
4. Cotton = $\frac{347}{8148}$ x 360 = 15°
5. Maize = $\frac{1408}{8148}$ x 360 = 62°

Table – 7: Yield and water utilization (Flood Versus Drip) in Field Crops

Crop	Yield in kg/acare			Water use M^3/are		
	Flood	Drip	Difference in Percent	Flood	Drip	Difference in Percent
Sugarcane	30000	70000	133.33	9800	4960	49.39
Cotton	904	1700	88.05	3600	1680	53.33
Potato	6060	10880	79.54	2400	1100	54.17
Chickpea	1254	2200	75.44	1808	1048	42.04
Chilies	912	1520	66.67	1708	980	42.62
Onion	14625	22500	53.85	2080	1120	46.15
Grain	800	1400	75.00	2304	1500	34.50
Groundnut	1692	2436	43.97	2620	1680	35.88

Source: The Hindu Survey of Indian Agriculture, 2006.

The results come from the field and are not scientifically proven, but consider us an idea of the impact of the drip irrigation technology in most of the Indian crops. The results have been gathered from tens of farmers in several states of India.

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Table – 8: Yield and water utilization (Flood Versus Drip) in Fruits'

Crop	Yield in kg/acare			Water use M^3/are		
	Flood	Drip	Difference in Percent	Flood	Drip	Difference in Percent
Papaya	5200	9200	76.92	9120	2920	67.98
Sweet lime	4000	6000	50.00	6640	2560	61.45
Mosambi	40000	60000	50.00	640	2560	61.45
Pomegranate	6050	11700	93.39	3920	2196	43.98
Mango	3000	5400	80.00	5100	3324	34.82
Banana	23000	35000	52.17	7040	3880	44.89
Watermelon	9610	15500	61.29	1680	1000	40.48
Grapes	8000	12000	50.00	3520	2320	34.09
Kinnow	2720	3920	44.12	884	692	21.72
Guava/tree	160	220	37.50	6	5	18.75

Source: The Hindu Survey of Indian Agriculture, 2006.

Another technology which has a tremendous impact in agriculture in the last 15-20 years is the protected environment agriculture.

The drip irrigation sector in India had a tremendous boost recently, as a result of the decision taken by some of the local governments (Andhra Pradesh, Tamilnadu and Gujarat among others) and also the central government, to allocate special funds under very strict guidelines, for the implementation of micro irrigation in a massive scale in India [6].

These micro irrigation projects already are having a tremendous impact on several aspects and besides bigger yields obtained by farmers in their fields, the macro economical aspects, as saving of water and power are being observed clearly. There is no doubt that the implementation of technology in the agro sector, by way of drip irrigation and protected environment will make the agro sector contribute in a large measure to the GDP growth of the country and this will be achieved efficiently and in an environment friendly way.

The step by step priorities for planning development implement action and management of water are as follows
Step-1

Consider a village / habitation or a cluster of near by villages as a hydrological unit for planning and implementation of micro watershed. Harness and rain water sheer it first falls. Create percolation tanks, farm ponds, farm wells, mullah – bunds, other appropriate rain water conservation and collection structures on rivulets and or rivers in the vicinity of the village area. This will be the first step in the direction of making the village self sufficient in terms of its requirements.

Step-2

The available surplus water from the micro watershed would then be stored in minor dams, which may be one or more and preferably many, taking into consideration expanse of the command area and density of the population enrooted or in the vicinity. Repeat conservation and collection structures on the stream created by the over flow of the minor dam / dams and the management practices and procedure as detailed in step 1.

Step-3

The surplus from the minor dam / dams would then be dammed through a medium sized project only after rehabilitation of the affected population is completed. If need be legislative authority should be sought and used for competing the affected people to be site themes less in the colonies specially equipped and created for the purposes in the larger interest. Certain measure of such concern is just and justifiable.

Step-4

Surplus water available from medium irrigation project may be stored by construction of a major irrigation dam only after rehabilitation of affected people or displaced population is completed. Even at the cost of repetition the author has to emphasize that no effective steps. Except survey and planning should own be taken for construction of the major irrigation dam unless and until resettlement of the project affected people is completed in the colonies specially created for them. These colonies must have al the required amenities including roads electricity drinking water educational institutions market health centers other social infrastructure and agricultural lands of the type, acreage and equality each one of the affected families possessed prior to displacement.

National Water Mission

The mission has five goals.

1. Comprehensive water database in public domain and assessment of impact of climate change on water resources – Collect comprehensive data on water resources, develop water resources information system by 2011, make information available in the public domain, assess the impacts of climate change on the country's water resources by 2012. Scientific data collection includes additional hydro-meteorological data, well and inventory, reassessment of basin-wise water situation and finally, using this data to predict the impacts.

2. Promote citizen and state action for water conservation, augmentation and preservation –

includes expeditious implementation of irrigation projects, minor irrigation schemes, ground water development, mapping flood-affected areas, capacity-building and awareness.

3. Focused attention on over exploited areas – intensive rainwater harvesting and groundwater recharge programs, pursuing enactment of groundwater regulation and management bill.

4. Increasing water use efficiency by 20 percent – both on the demand side and the supply side, particularly in the agriculture and commercial sectors. Guidelines for incentivizing recycled water, water neutral and water-positive technologies, improving efficiency of urban water supply systems, benchmark studies for urban water use, water efficiency indices for urban areas, manuals for mandatory water audits in drinking water irrigation and urban systems, promoting water efficient techniques including sprinkler and drip irrigation systems.

5. Promote basin-level integrated water resources management basin level management strategies, review of National Water Policy in order to ensure integrated water resources management, appropriate entitlement and appropriate pricing.

Important Features

1. Review of National Water policy

2. Research and studies on all aspects related to impact of climate change on water resources including quality aspects of water resources.

3. Expeditious implementation of water resources projects particularly the multipurpose projects with carry over storage.

4. Promotion of traditional system of water conservation

5. Incentivize for recycling of water including waste water

6. Planning on the principle of integrated water resources development and management.

7. Ensuring convergence among various water resources programs and intensive capacity building and awareness program including those for Panchayati Raj Instituttions, urban local bodies and youths.

8. Sensitization of elected representative of over exploited area on dimensions of the problems and to orient investment under NREGA towards water conservation.

Implosions of climate change on Water resource

1. Decline in the glaciers and the snowfields in the Himalayas

2. Increased drought like situations due to overall decrease in the number of rainy days over a major part of the country

3. Increased flood events due to overall increase in the rainy days intensity

4. Effect on groundwater quality in alluvial aquifers due to increased flood and drought events

5. Influence on groundwater recharge due to changes in precipitation and evapo-transpiration

6. Increased saline intrusion of coastal and island aquifers due to rising sea levels.

CONCLUSION

As the human population increases, greater demands are placed upon the available resources. At present world environment is suffering critical stress not only by utilization of its natural resources but also with the environmental damage inflicted by deforestation, species loss and climate change due to which widespread adverse effects, may trigger unpredictable collapse of critical biological systems where interactions and dynamics are understood imperfectly. Thus, there must be a holistic way of thinking regarding the management of our land and water resources. The forests crop lands, grazing lands, wildlife are all interrelated and integrated. Keeping the above points in view the following guidelines were outlined in the world conservation Strategy of United Nation.

To maintain essential ecological processes and life support systems in natural ecosystems on which human survival and development depends, which can be defined to include maintenance of both the biotic and a biotic components of the system.

To preserve genetic diversity on which depend the breeding programmes necessary for the protection and improvement of cultivated plants and domesticated animals, as well as much scientific advance, technical innovation, and the security of the many industries that used living resources.

To ensure the sustainable utilization of species and ecosystems. This will include the proper utilization of wild animals for game, forest and grazing, and to achieve proper integration for economy both of rural communities as well as trade and industry.

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