

Times of Agriculture

A Resonance in Agriculture

A Monthly e-Magazine

February, 2021

Special Issue

Lockdown

&

ENVIRONMENT

Lockdown

Impact on
Environment





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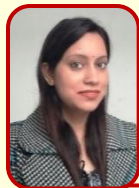


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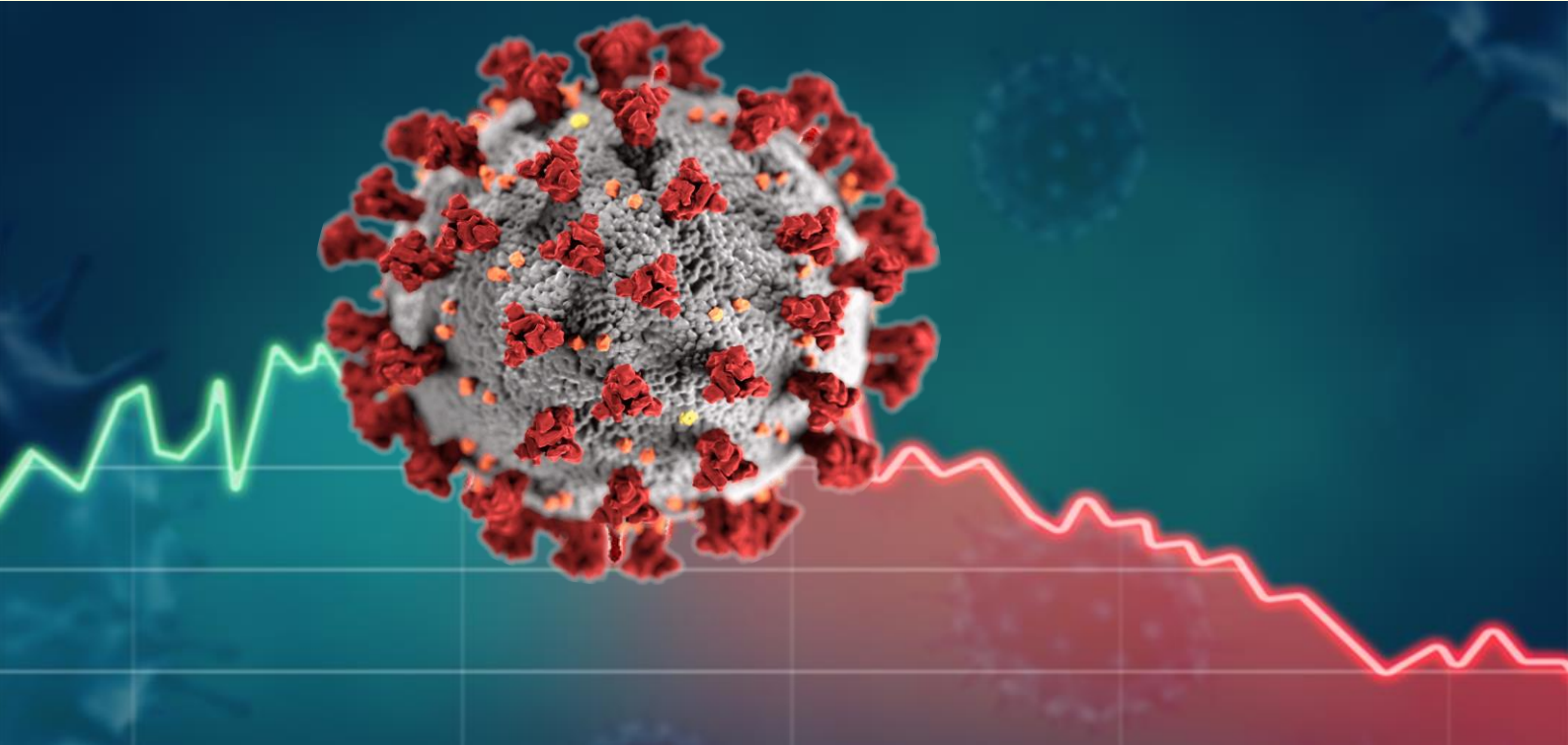
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IMPACT OF LOCKDOWN ON ENVIRONMENT



As of mid-April 2020, the disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is affecting about 210 countries and territories around the world. Over 2 million cases of virus infection were reported all over the globe, with most fatalities reported in the United States of America, Spain, and Italy. Originated initially in December 2019 in Wuhan, China, the coronavirus disease 2019 (COVID-19) spread swiftly from person to person from respiratory droplets when an infected person coughs, sneezes, or talks. Or, it spread by touching a surface or object that has the virus on it, and then by touching the mouth, nose, or eyes. Since there is no vaccine or medicine currently to prevent or cure the COVID-19, the World Health Organization and governmental bodies requested people for practicing social distance, avoid public transportation, and separate oneself from other people. Several countries and territories made swift and stern action to keep people stay at their homes by shutting down schools, industries, businesses, suspended travels, and closed the international and state boundaries. Normal life has come to a standstill around the globe since February 2020.



What is Covid 19 ?

Covid- 19 is a new strain of coronavirus that is similar to the SARS and MERS viruses. It causes respiratory illness and can even cause death. Wuhan, the 7th largest city in China, is the epicenter of a virus outbreak the capital of the Hubei Province in mainland China. Chinese ophthalmologist Li Wenliang, who had first shared suspicion of a Sars-like illness spreading in Wuhan, died due to coronavirus. It is considered a novel virus outbreak because the virus is novel (new – not seen earlier).



Li Wenliang

Timeline

On 30 January, India reported its first case of COVID-19 in Kerala, which rose to three cases by 3 February. The **World Health Organization (WHO)** on March 11, 2020, has declared the novel coronavirus (COVID-19) outbreak global pandemic. On 12 March, a 76-year -old man, with a travel history to Saudi Arabia, became the first COVID-19 fatality of India.



Lockdown: What & Why ?

According to the government, lockdown is defined as an emergency protocol that is implemented by the authorities to prevent people from leaving their homes or a particular area. When a lockdown is implemented people are not allowed to travel or go outside their houses like before. Essential service like groceries, medications, banks are only allowed to function in this crucial time. The lockdown was implemented from midnight (March 25) for 21 days (April 14). According to the all-India data by the Ministry of Health and Family Welfare, the number of coronavirus positive cases that were



doubling every three days initially have after the lockdown started to double every six days.

Impact on Air Quality

Due to the coronavirus outbreak's impact on travel and industry, many regions and the planet as a whole experienced a drop in air pollution. Reducing air pollution can reduce both climate change and COVID-19 risks but it is not yet clear which types of air pollution (if any) are common risks to both climate change and COVID-19. The Centre for Research on Energy and Clean Air reported that methods to contain the spread of coronavirus, such as quarantines and travel bans, resulted in a 25 per cent reduction of carbon emission in China.

Some of the important air quality parameters improved during lockdown are as follow:

Parameters (CPCB)*

1. **PM_{2.5} & PM₁₀**
2. **Ammonia**
3. **Nitrous Oxide**
4. **Sulfur Dioxide**
5. **Carbon Monoxide**



*The Central Pollution Control Board (CPCB) is a statutory organization under the Ministry of Environment, Forest and Climate Change (Mo.E.F.C). It was established in 1974 under the Water (Prevention and Control of pollution) Act, 1974.



**Ministry of Environment,
Forest and Climate Change**
Government of India



In compare to the last year (i.e. 2019) during the said time period the reduction of PM₁₀ and PM 2.5 is as high as about 60% and 39% respectively. Other pollutants that have shown considerable variation between pre and during lockdown are NO₂ (−52.68%) and CO (−30.35%). However, for SO₂ (−17.97%), and NH₃ (−12.33%) the reduction have counted very low in comparison to the others. About 40% to 50% improvement in air quality is identified just after four days of commencing lockdown. About 54%, 49%, 43%, 37% and 31% reduction in NAQI have been observed in Central, Eastern, Southern, Western and Northern parts of the megacity. In China, lockdown and other measures resulted in a 25 per cent reduction in carbon emissions and 50 per cent reduction in nitrogen oxides emissions, which one Earth systems scientist estimated may have saved at least 77,000 lives over two months.



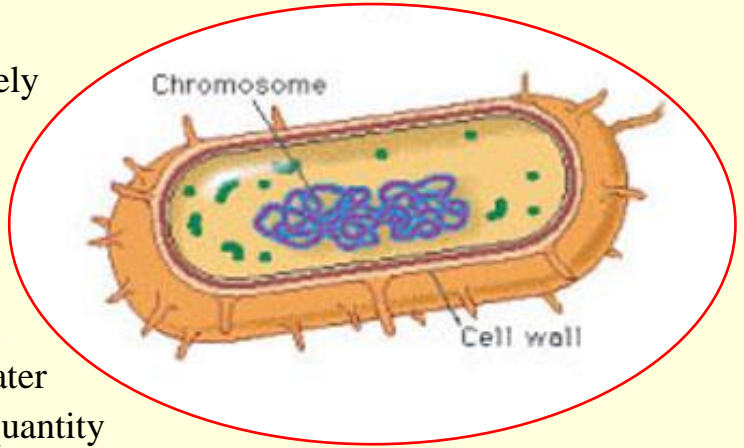
Comparative figure of before and after lockdown

Impact on water quality

The nationwide lockdown, imposed on mid night of March, 24, 2020, to curb spread of COVID 19 has resulted in overall improvement in water quality of River Ganga especially with regard to increased Dissolved Oxygen (and reduced nitrate concentration). This may primarily be attributed to absence of industrial wastewater discharge, agricultural runoff and increased fresh water flow. The reduction in Biochemical Oxygen Demand (and Chemical Oxygen



Demand (concentration was relatively less due to continued discharge of domestic wastewater into the river. It is pertinent to mention that domestic wastewater from 97 towns situated near river Ganga and industrial effluent are main sources of water pollution in the river with estimated quantity of 3500 MLD (Million Liters per Day) of sewage, out of which 1100 MLD is treated and remaining 2400 MLD gets discharged untreated. Industrial effluent is estimated to be about 300 MLD, which is about 9 of total wastewater being discharge d into the river every day. Reduced activities at Ghats and entrainment of solid organic waste into the river may also have contributed to better water quality.



Water quality data of monitoring stations at Kanpur

Parameters	Criteria limit (River)	Observed Value
DO (mg/l)	≥ 5 mg/l	8.70
BOD (mg/l)	≤ 3 mg/l	3
pH	6.5 - 8.5	7.1
NH ₃ (mg/l)	≤ 1.2 mg/l	1.1
COD (mg/l)	< 10 mg/l	9
Fecal coliform	Maximum permissible limit of fecal coliform is 2500 MPN	1300 MPN/100ml (March 13) 820 MPN/100ml (April 9)

(News18 Buzz, 2020)



Popular News Coverage's

Researchers believe that the self-cleansing property of river Ganga has improved which has enhanced the water quality by **40–50%** during this lockdown (Hindustan Times, 2020).

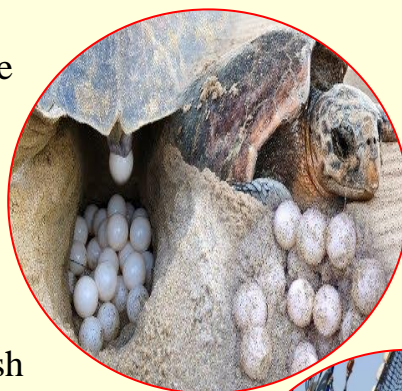
The pollution discharge has drastically fallen sharply in Buddha nullah which carries effluents from 2423 industrial units into Sutlej River in Punjab during this lockdown (Hindustan Times, 2020).

As per Karnataka State Pollution Control Board, the quality of water in Cauvery and tributaries like Kabini, Hemavati, Shimsha and Lakshamanathirtha is also back to what it used to be before decades (The Hindu, 2020).

Scientists have claimed that water quality has remarkably improved at Haridwar Ghats which is up to drinking standards (News18 Buzz, 2020).

Impact on wildlife

As people stayed at home due to lockdown and travel restrictions, some Animals have been spotted in cities due to lockdown and travel restrictions. Fish biomass will increase due to the sharp decline in fishing. Fish prices and demand for fish have decreased due to the pandemic. Sea turtles were spotted laying eggs on beaches. Fatal vehicle collisions with animals such as deer, elk, moose, bears, mountain lions fell by 58% during March and April.



Impact on soil

Soil were adversely affected during the period of lockdown due to mismanagement of biomedical waste and enhanced consumption of take-away food delivered with single-use packaging.

Single-use masks, gloves and bottles of sanitizer shielding and other personal protective equipment (PPE) are critical for those fighting the pandemic but are also widely used by the public. Still, because they're not always disposed of properly, environmentalists fear negative consequences for soil and the fight against plastic pollution. India is likely to generate about 775.5 tonnes of medical waste per day by 2022 from the current level of 550.9 tonnes daily, a study conducted jointly by industry body ASSOCHAM and Velocity has said.



Impact on environmental monitoring and prediction

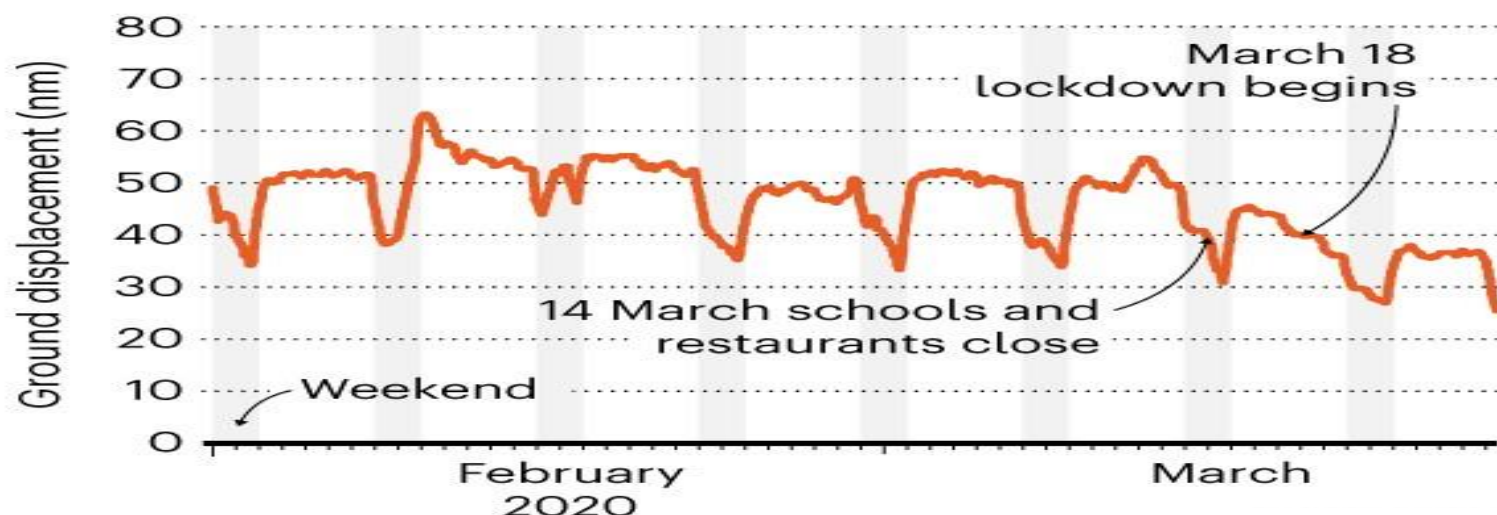
Weather forecasts

The European Centre for Medium-Range Weather Forecasts (ECMWF) announced that a worldwide reduction in aircraft flights due to the pandemic could impact the accuracy of weather forecasts.



SEISMIC NOISE

In Belgium, vibrations caused by human activity have fallen by about one-third since coronavirus containment measures were introduced.



Seismic noise reduction

Seismologists have reported that quarantine, lockdown, and other measures to mitigate COVID-19 have resulted in a mean global high-frequency. Seismic noise reduction of 50%. The study states that the reduced noise level may allow for better monitoring and detection of natural seismic sources, such as earthquakes and volcanic activity.

Handwashing helps stop COVID-19 But in India, water is scarce



For this country especially, that's quite a lot of handwashing. A single 20-second wash plus wetting and rinsing uses at least two liters of water, more than half a gallon. For a family of four washing **10 times** a day each, that's **80 liters** just for handwashing—an unimaginable luxury in much of rural India. (The average American uses **100 gallons**—around **379 liters**—of water daily.)



Last year, Chennai, India's sixth-largest city, ran out of water during a prolonged drought. The **NITI Aayog**, a policy think tank for the Indian government, released a report on the country's ongoing water crisis that found 82 percent of rural households, 146 million homes in all, do not have piped running water. Nearly 60 percent of urban households don't either.



NITI Aayog

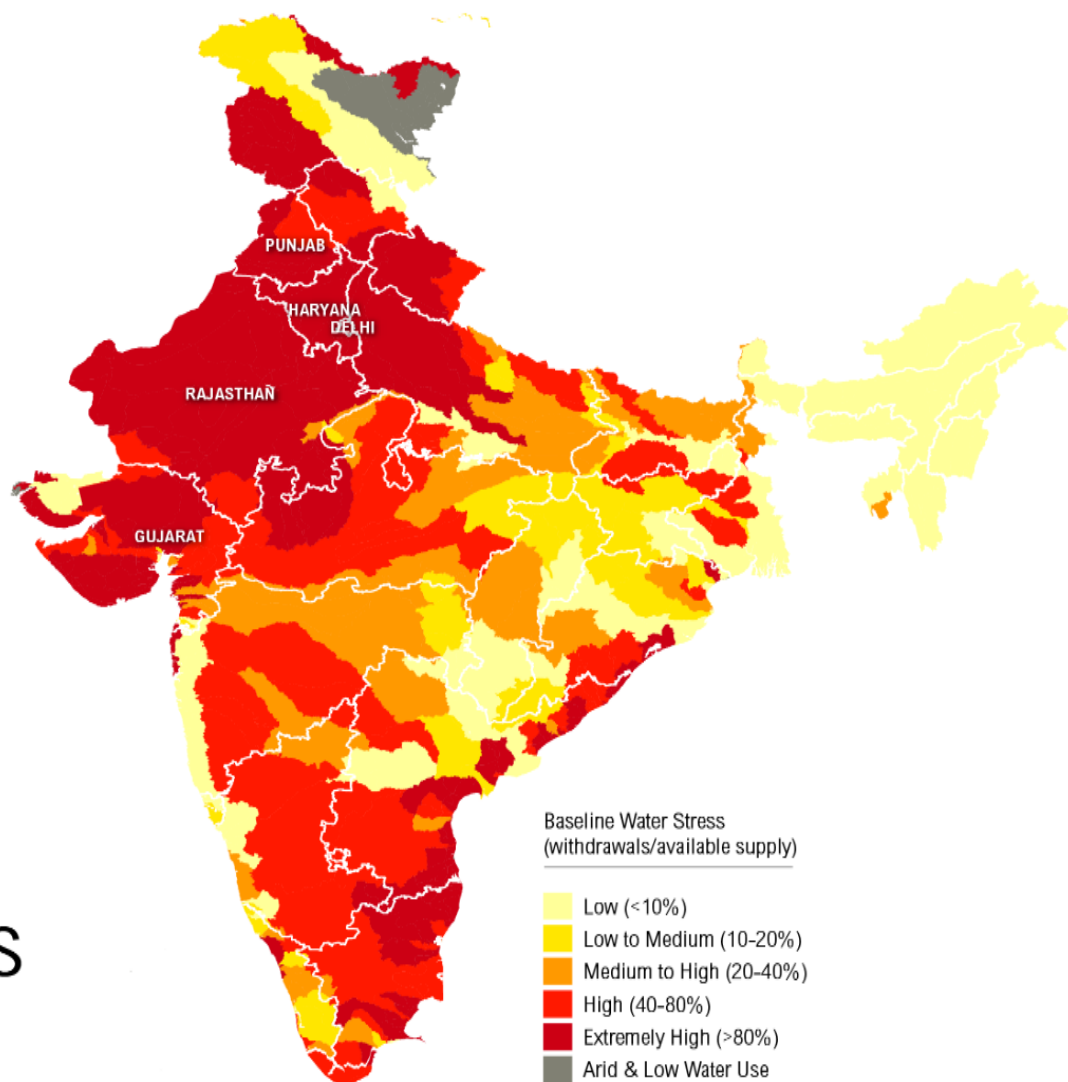


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54%
of India
Faces
**High to
Extremely
High**
Water Stress



 WORLD RESOURCES INSTITUTE

Conclusion

COVID-19 a new strain of coronavirus that is similar to the SARS and MERS viruses. It originated in China. It causes respiratory illness and can even cause death. Due to lockdown there is improvement in air quality, water quality, environment, increase in accuracy of weather forecast and Seismic noise reduction of 50%. Due to lockdown there is increase in soil pollution due to mismanagement of biomedical waste and water scarcity will be happen due to overutilization of water during lockdown.

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Validity & Reliability

RELIABILITY AND VALIDITY OF TOOLS

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Definitions of reliability

Synonyms for reliability are: depending, stability, predictability, accuracy. For example A reliable man, for instance, is a man whose behaviour is consistent, dependable and predictable- what he will be consistent with what he does today and what he has done last week. We say he is stable. An unreliable man, on the other hand, is one whose behaviour is much more variable. So it is with psychological and educational measurements: they are more or less variable from occasion to occasion. If they are reliable, we can depend on them. If they are unreliable, we cannot depend upon them.

It is possible to approach the definition of reliability in three ways. One way is epitomised by the question: If we measure the same set of objects again and again with the same or comparable measuring instrument, will we get the same or similar results?. This question implies a definition of reliability in stability, dependability and predictability terms. It is the definition most often given in elementary discussion of the subject.

A second approach is epitomised by the question: Are the measures obtained from measuring instruments the “true” measures of the property measured? This is an accuracy definition. These two approaches and definitions can be summarised in the word accuracy and stability. Third definition is: We can inquire how much error of measurement there is in a measuring instrument?. For understanding this definition first we have to understand what is variance?

Variance is the amount by which something changes or different from something else. There are generally two types of variance – Systematic Variance leans in one direction: scores tend to be all positive or all negative or all high or low. Error in this case is constant or biased. Random or error variance is self-compensating: scores tend now to lean this way, now that way. Errors of measurement of tools are random errors.

This question implies that Reliability can be defined as the relative absence of errors of measurement in a measuring instrument or tools. Reliability is the accuracy or precision of measuring instruments.

Theory of reliability

The total obtained variance of a test is made up of two variance components, a **true** component and an **error** component.

$$V_t = V_{\sim} + V_e$$

$$V_t = \text{Total variance}$$

$$V_{\sim} = \text{True variance}$$

$$V_e = \text{Error variance}$$



1. Reliability is the proportion of the “true” variance to the total obtained variance of the data yielded by a measuring instrument.
2. Reliability is the proportion of error variance to the total obtained variance yielded by a measuring instrument subtracted from 1.00, the index 1.00 indicating perfect reliability.

It is easier to write these definitions in equation form:

$$R_t = V_{\sim} \div V_t$$

$$R_t = 1 - (V_e \div V_t)$$

Methods of determining the reliability of an instrument:

There are a number of ways of determining the reliability of an instrument. The various procedures can be classified into two groups:

1. External consistency procedure
2. Internal consistency procedure

External consistency procedure:

External consistency procedure compares finding from two independent process of data collection with each other as a means of verifying the stability and accuracy of the one finding from other finding.

As an equation:

$$(\text{Test score}) / (\text{Re test score}) = 1$$

Or

$$(\text{Test score}) - (\text{Re test score}) = 0$$

This equation shows the test retest method of testing internal consistency of the procedure.

In the test/ re test reliability repeated measurements of the same person or group using the same scale under the similar condition are taken. A ratio of one shows 100% reliability (no difference between test and re test) and any deviation from it indicates less reliability – the

less the value of this ratio, the less the reliability of an instrument. Expressed in another way, zero difference between the test and re test scores is an indication of 100% reliability. The greater the difference between the test scores/ findings, the greater the unreliability of the instrument.

Advantages:

The main advantage of the test / re test procedure is that it permits the instrument to be compared with itself, thus avoiding the sort of problems that could arise with the use of another instrument.

Disadvantages:

The main disadvantage is that a respondents may recall the responses that he/she gave in the first round, which in turn may affect the reliability of the instrument.

Where an instrument is reactive in nature (when an instrument educates the respondent with respect to what the researcher is trying to find out) this method will not provide an accurate assessment of its reliability. One of the way of overcoming this problem is to increase the time span between the two tests, but this may affect reliability for other reasons, such as the maturation of respondents and the impossibility of achieving conditions similar to those under which the questionnaire was first administered.

Parallel forms of the same test:

In this procedure we construct two instruments that are intended to measure the same phenomenon. The two instruments are then administered to two similar populations. The result obtained from one test are compared with those obtained from the other. If they are similar, it is assumed that the instruments are reliable.

Advantages:



The main advantage of this procedure is that it doesn't suffer from the problem of recall found in the test/ re test procedure. Also a time lapse between the two tests is not required.

Disadvantages:

A disadvantage is that you need to construct two instruments instead of one. Moreover, it is extremely difficult to construct two instruments that are comparable in their measurement of a phenomenon. It is equally difficult to achieve compatibility in the two population groups and in the two conditions under which the test are administered.

Internal consistency procedure:

Internal consistency reliability indicates the homogeneity of the test. If all the items of the test measure the same function or traits, the test is said to be homogenous.

The split half technique:

This technique is designed to correlate half of the items with the other half and is appropriate for instruments that are designed to measure attitude towards an issue or phenomenon.

The questions or statements are divided in half in such a way any two questions or statements intended to measure the same aspect fall into different halves. The score obtained by administering the two halves are correlated. Reliability is calculated by using the product moment correlation between scores obtained from the two halves. Because the product moment correlation is calculated on the basis of only half the instrument, it needs to be corrected to assess reliability for the whole. This is known as stepped up reliability.

The stepped up reliability for the whole instrument is calculated by a formula called the Spearman – Brown formula.

Reliability of the whole test = $2 \times \text{reliability of the half test} / 1 + \text{reliability of the half test}$

Validity:

The validity of a scale refers to the question whether we are measuring what we want to measure. Validity of the scale refers to the extent to which the measurement process is free from both Systematic and Random error variance. The validity of scale is a more serious issue than reliability.

There are different ways to measure validity:

Content or face validity:

The judgement that an instrument is measuring what it's supposed to is primarily based upon the logical link between the questions and the objective of the study.

Concurrent validity:

It is used to measure the validity of the new measuring techniques by correlating them with the established techniques. It involves computing the correlation coefficient of two measures of the same phenomenon (for example perception of airline and image of a company) which are administered at the same time.

Predictive validity:

This involves the ability of a measured phenomenon at one point of time to predict another phenomenon at a future point of time. If the correlation coefficient between the two is high, the initial measure is said to have a high predictive ability.



Construct validity:

Construct validity is a more sophisticated techniques for establishing the validity of an instrument. It is based upon statistical procedure. It is determined by ascertaining the contribution of each construct to the total variance observed in a phenomenon.

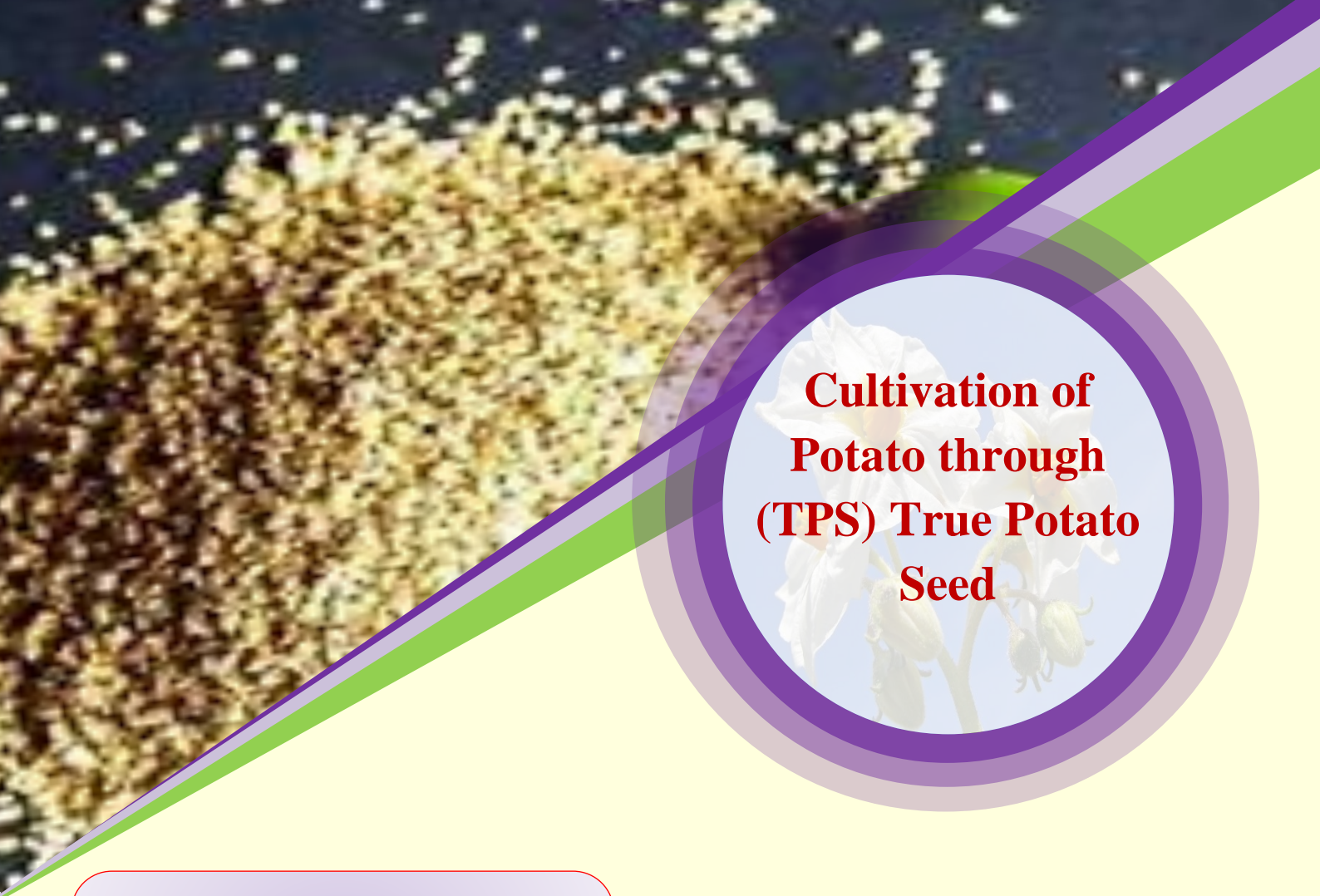
Conclusion

It is conclude that reliability is the degree to which a test consistently measures whatever it measures whereas validity is the extent to which a test measures or what is supposed to measure. Relationship between validity and reliability shows that reliability is prerequisite for measurement of validity and one needs reliability but it is not enough.

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Cultivation of Potato through (TPS) True Potato Seed

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Introduction

Potato is a widely used as vegetable in India but the country is still far behind in per capita consumption of potatoes than the developed countries. In India the average per capita annual availability for consumption is about 14 kg against 19 kg in Asia and 32 kg in the world. Potato is traditionally grown by vegetative true seed tuber. TPS minimize to overcome the problem of total cost of potato production. TPS concepts was first realized to raise commercial crop in India by **Dr. S. Ramanujan** (The first Director of CPRI).

What is TPS ?

TPS means the matured ovule developing in berry of the potato plant as a result of sexual reproduction/ fertilization.

Advantages of TPS

- Free from pathogens
- Easy storage and transport
- Low cost
- Very low seed rate
- New potato producing areas
- Flexible planting time

Importance of TPS

100 grams of seed is sufficient to cover one hectare area instead of planting 2-2.5 tons of potato seed tuber. Being hybrid, it is capable of giving more production and is absolutely diseases free seed material. Cold storage facility is necessary for storing T.P.S. and is comparatively more resistance to the infestation



of pests and diseases. As it required less seed per hectare so net profit is more.

Climate

Potato is basically a temperate crop and optimum temperature for potato growth and development ranges from 15 to 25°C. Temperature below 21°C favors tuberization. Long photo period favors haulm growth but delays maturity.

Soil

Potato is grown in all types of soils but light, well-drained sandy loam soils are best-suited. In India, maximum area under potato is in alluvial soils, followed by hill, black and red soils. Potato prefers soils in acidic neutral range (pH 5.5 - 6.0).

TPS production in plains

If the TPS parents are planted in the plains, there is generally need to provide extra light for about 5 hours at the end of the day to prolong the day length and get proper flowering. Hence, select such a field for planting as hybridization block, where in, arrangements can be made for providing light from 150 W Sodium Vapor Lamp (one for about every 100 sq.m.)

Varieties of TPS

Alaska Red	TPS/ C-3
92-PT-27	HPS-I/13
JTH/C-107	Dutch Blue
Kerr's Pink	Kufri Jeevan

Sowing of TPS

1. Direct sowing in field
2. Sowing in nursery bed
 - (a). Transplant as seedling crop
 - (b). Seedling tubers production

Direct seeding

It requires 100-150 g TPS per ha (if 75% germination). Beds should be pre-irrigated. Sowing of seed by dibbling method, requires seeds to be sown in thin 0.5 cm deep furrows marked 45-50 cm apart. At two leaf stage seedlings may be sprayed with 0.1% urea at 3-4 days interval and earthing up and weeding operations are done as per requirement.

Problems

- (a) Poor Germination
- (b) Mortality of seedlings

Sowing in nursery bed

Prepare raised nursery beds with substrate i.e., soil and decomposed cow dung. Apply fertilizers @ 4-5g N; 6-8g P₂O₅ & 10g K₂O per m². Sown seeds by dibbling at 0.5 cm deep in furrows marked about 5 cm. About 125 g TPS and 75 sq. meter nursery bed area is needed to produce seedling for transplanting in one hectare and for seedling tuber production keep 80-100 seedlings per m². At two leaf stage seedlings may be sprayed with 0.1% urea at 3 - 4 days interval. Weeding and earthing are done as per requirement up as required.

Seedling transplant crop

Make small ridges and furrows spaced 45-50 cm apart and 2-3 days before transplanting irrigate the field up to 1/3 of the ridge. Transplant seedlings at 4-5 leaf stage at the water mark on the north facing side of the ridge. Earthing up operations are done at 25-30 days & 50-60 days after transplanting. Apply recommended basal fertilizer dose with ½ N in 2 equal split top dressing. Dehaulming is done at maturity and harvest after 10-15 days of dehaulming.



Practices of production of Seed tubers using TPS

At present there are two methods in practice for producing seedling tubers in bed:

- (a) Single row method.
- (b) Double row method.

Single row method

Prepare beds of 6 inches or 15 cm height, 1 m width and according to convenient length at 75 cm apart. Soil should be brought to fine tilth by incorporating well-rotten FYM. Apply Urea, S.S.P and S.O.P. @ 20, 6 & 25 g/sq. m as basal dose and sow 2-3 seeds per hole at 0.5 cm depth with 20 X 5 cm spacing. Provide shade to avoid sun scorching and irrigate the beds with fine rose cane as per necessity. Earth up with the mixture of finely prepared soil and FYM along with Urea @ 5 g/sq. m at 30, 45 and 60 DAS & cut the haulms at 85 day. Treat the Tuber with 3% Boric-acid and store in cold storage for next year after proper drying in shade.

Double row method

Preparation of field and other operation are same as single row method except sowing of seeds. In this method seeds are sown 4 cm apart in a line and row to row distance is 10 cm. In between two double row distance is 30 cm. Top dressing with 5 gm of Urea per q. m at 30th, 45th and 60th day followed by earthing up as practiced in normal crop so that two lines can be covered by a single furrow.

Manures and fertilizers

Potato being a shallow-rooted crop, requires high nutrients. It needs 100-120 kg N, 50-60 kg P₂O₅ and 100-120 kg K₂O /ha. The response to NPK depends not only upon the fertility status

of soils but also on variety, cropping system and source of nutrients.

Intercultural Operations

This is done to bring the soil loose and destroy the weeds. The first earthing-up should be done when plants are 15-25 cm height. The second earthing-up is often required later to cover up the tubers properly.

Weed control

Herbicides like Metribuzin (Sensor) @ (1.0 kg a.i./ha) applied as pre-emergence spray are effective. Lasso (Alachlor) @ 2 liters /ha can also be used.

Seed extraction

Berries are harvested after about 8 weeks of pollination and allowed to ripen at room temperature till these become soft enough for seed extraction by maceration. Shade dried seeds are exposed to sun for one hour and further dried on silica gel till moisture is <5%, and dried seeds are sealed in aluminum foil packets.

Yield

From a well cultivated potato field we can obtain 35-40 tonnes / ha yield. TPS yields about 90 - 100kg /ha.

Conclusion

Cost of cultivation can be minimized (40%) by using true potato seed. TPS have 100% genetic purity and it also prevent the incidence of insect, pest & diseases to a much greater extent. TPS is better than tubers because of inexpensive storage & transport.





A1 AND A2 COW MILK



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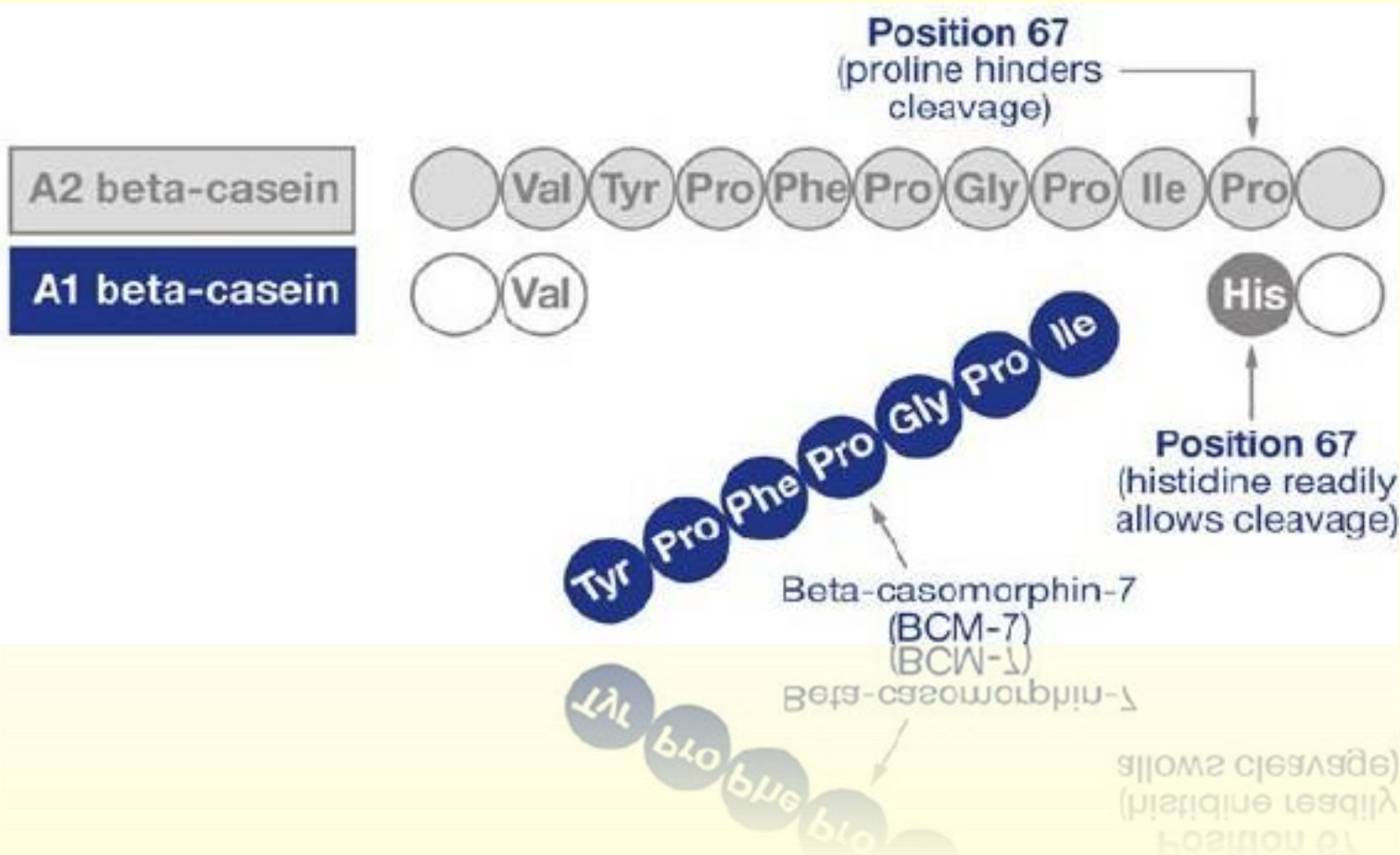
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Cow milk comprises 85% Water, 4.6% Lactose, 3.7% Triacylglycerols (fat), 3.5% protein, 0.54% minerals and 3.36% miscellaneous other nutrients. Protein is made up of one or more chains of the polypeptide, which comprises amino acids as the monomer. There are 20 types of amino acids generally observed in proteins. Amino acids are linked to each other through a peptide bond. Cow milk consists of two types of protein, casein, and whey which represent 80% and 20% of whole milk protein respectively.

Casein consists of four fractions, namely α_1 , α_2 , β and κ -casein, and whey proteins consists, Beta-Lactoglobulin and Alpha-Lactalbumin. β -casein forms about 25-30% of cow's milk proteins and consists of 209 amino acids. Throughout the evolution of thousands of years, some mutations happen in the amino acid sequence of β -casein. These changes transfer from generation to generation, which ultimately gives rise to a different variant of β -casein. There are various genetically determined variants of β -casein. These variants are A1 β -casein, A2 β -casein, A3 β -casein, B β -casein, C β -casein. The milk with A1 β -casein variant is called A1 cow Milk. Milk with A2 β -casein variant is called A2 cow milk. The distinction among these two proteins is owing to the different amino acid present at the 67th position in this chain of 209 amino acids found in β -casein. A1 milk consists of histidine at the 67th position whereas A2 consists of proline at the same position. Rest amino acids are the same in this protein. A1 type variant is present in crossbred and European breeds of cattle whereas A2 type variant is present in indigenous breeds of cattle in India. Enzymatic cleavage of A1 β -casein





leads to the production of seven amino acid peptide, known as β -casomorphin7 (BCM-7), whereas no BCM-7 is produced upon digestion of A2 milk due to the presence of proline which prevents the peptide chain from digestion. BCM-7 is a strong opioid and is released in the small intestine. The A1 β -casein variant has been associated as a possible risk factor in numerous diseases, such as type-1 diabetes mellitus, ischaemic heart disease,

schizophrenia, and autism. So, from a Health perspective, A2 Milk is superior and have health promotional benefits in comparison to A2 Milk. Milk obtained from indigenous breeds of cows is A2 whereas A1 milk is derived from exotic breeds, Jersey, Holstein Friesian.





Smart Farming the Future Agriculture

Components of smart farming

- A. Internet of Things (IOT)
- B. Precision farming/ precision agriculture/ remote sensing
- C. Management Information System– (MIS)/ Control Center
- D. Geographic Information Systems- (GIS)
- E. Spatial Decision Support Systems- (SDSS)

(A) Smart farming IOT

Smart farming is the term used to describe the adoption of modern information and communications technologies in order to enhance, monitor, automate or improve agricultural operations and processes. Sensors collect information such as soil moisture, fertilization, weather and transmit that through a gateway over cellular wireless network to a central hub providing farmers real time access to information and analysis on their land, crop, livestock, logistics and machinery.

Application of smart farming IOT

Irrigation system are one of the most common features of any farm or agricultural site. In order to optimize irrigation system, farmers could access data collected from remote sensors and use it to analyze where their water resources should direct, in what kind of volume



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Smart Farming is a farming management concept using modern technology to increase the quantity and quality of agricultural products. Farmers in the 21st century have access to GPS, soil scanning, data management, and Internet of Things technologies. By precisely measuring variations within a field and adapting the strategy accordingly, farmers can greatly increase the effectiveness of pesticides and fertilizers, and use them more selectively. Similarly, using Smart Farming techniques, farmers can better monitor the needs of individual animals and adjust their nutrition correspondingly, thereby preventing disease and enhancing herd health.



and for how long, and all from their connected laptop tablet or smart phone.

(a) Fertigation:

Fertigation is defined as the injection of fertilizers, soil amendments and other products typically needed by farmers into soil. With an IOT enabled fertigation solution, farmers could remotely control how many fertilizers are injected and within what volumes. It would also enable them to monitor fertilizer concentrations and other environmental condition, such as pH, in the soil using remote sensors and adjust to the required levels if necessary.

(b) Livestock Safety and Maturity Monitoring:

Anyone who, even worked on a livestock farm will tell you that, sometimes, animals tend to wander off. With IOT – enable sensors producing real time biomedical data on livestock such as body temperature, pulse and even tissue resistivity.

(c) Crop communication:

As the world becomes ever hungrier, farms will need to be able to keep up with global crop requirements. In order to do so, smart farming IOT solution can be deployed to enhance production, minimize waste and costs and improve resource consumption. The ability to monitor the condition in which your latest crop is planted via your smart phone or tablet is something most farmers would jump upon if given the chance.

(d) Drilling, Seeding and Harvesting:

Driverless vehicles have a major application in Smart Farming IOT once that market matures. Remote controlled autonomous tractors built to do function such as drilling,

speeding and harvesting are already being deployed in pilot projects and have shown.

(e) Aerial Crop Monitoring:

Monitoring a vast field to expose issues related to soil variation, fungus and irrigation is quite challenging and costly to achieve in a timely fashion. But thanks to cheap drones, inexpensive but powerful processors, GPS and radio technology, now farm monitoring is not only affordable but way more precise. Now farmers can use time series animation to keep an eye on development on their crop and soil variation issues leading to more efficient crop management.

(B) Precision Agriculture

- ◎ This technique was used to derive the first input recommendation maps for fertilizers and pH corrections. The use of yield sensors developed from new technologies, combined with the advent of GPS receivers, has been gaining ground ever since. Today, such systems cover
- ◎ Precision agriculture (PA), satellite farming or site-specific crop management (SSCM) is a farming management concept based on observing, measuring and responding to inter and intra-field variability in crops.

Technologies of Precision Farming practices:

a. High precision positioning systems (like GPS): Are the key technology to achieve accuracy when driving in the field, providing navigation and positioning capability anywhere on earth, anytime under any all conditions.

b. Automated steering systems: Enable to take over specific driving tasks like auto-steering, overhead turning, following field edges and



overlapping of rows. These technologies reduce human error and are the key to effective site management.

c. Sensors and remote sensing: Collect data from a distance to evaluating soil and crop health (moisture, nutrients, compaction, crop diseases).

d. Remapping: Used to produce maps including soil type, nutrients levels etc.

e. Variable rate technology (VRT): Ability to adapt parameters on a machine to apply, for instance, seed or fertilizer according to the exact variations in plant growth, or soil nutrients and type.

(C) Geographic Information Systems- (GIS)

GIS are computer-based tools designed for both mapping and analyzing feature events on earth. GIS analyze soil data combined with historical farming practices in order to determine what are the best crops to plant, where they should be situated, what is the best way to maintain soil nutrition levels in order to give the greatest level of benefit to the plants. By mapping geographic and geologic features of current (and potential) farmland scientists and farmers can work together to create more effective and efficient farming techniques; this could increase food technology being developed by experts such as Micro Multi Copter Aero Technology.

(D) Spatial Decision Support Systems- (SDSS)

Spatial decision systems are extremely useful to solve spatial problems to make decisions regarding irrigation scheduling, fertilization, use of crop growth and regulators for other chemicals. For decision makers in a smart agriculture system, a spatial decision-support system allows them to:

- (a) From different data types, build both spatial and process-based relationships.
- (b) Merge multiple data layers into synthetic information.
- (c) Observe potentially competing alternatives and in turn weigh the outcomes.
- (d) Forecast.

Opportunities in Smart Farming:

While farmers have always sought information such as when to plant and harvest, now advanced technology is giving both large and small-scale farmers increasingly affordable and newly precise tools to produce more with less.

The report positions the humble mobile phone as the most important new agricultural tool, allowing farmers to access weather and climate data and connect to new customers. Precision farming is also important. Farmers adopting precision farming techniques can expect an 18% annual increase in income.

“It is increasingly difficult to grow outdoors with more volatile weather and pest issues, lack of water and arable land. Farming indoors enables us to grow all year round to a consistently high standard of quality. It also allows precision use of precious resources.

Advantages of smart farming:

- (a.) **Increased Production**– Optimized crop treatment such as accurate planting, watering, pesticide application and harvesting directly affects production rates.
- (b.) **Water Conservation**– Weather predictions and soil moisture sensors allow for water use only when and where needed.
- (c.) **Real-Time Data and Production Insight** – Farmers can visualize production levels, soil



moisture, sunlight intensity and more in real time and remotely to accelerate decision making process.

(d.) Lowered Operation Costs – Automating processes in planting, treatment and harvesting can reduce resource consumption, human error and overall cost.

(e.) Increased Quality of Production – Analyzing production quality and results in correlation to treatment can teach farmers to adjust processes to increase quality of the product.

(f.) Accurate Farm and Field Evaluation – Accurately tracking production rates by field over time allows for detailed predicting of future crop yield and value of a farm.

(g.) Improved Livestock Farming – Sensors and machines can be used to detect reproduction and health events earlier in animals. Geofencing location tracking can also improve livestock monitoring and management.

(h.) Reduced Environmental Footprint – All conservation efforts such as water usage and increased production per land unit directly affect the environmental footprint positively.

(i.) Remote Monitoring – Local and commercial farmers can monitor multiple fields in multiple locations around the globe from an internet connection. Decisions can be made in real-time and from anywhere.

(j.) Equipment Monitoring – Farming equipment can be monitored and maintained according to production rates, labor effectiveness and failure prediction.

Disadvantages of smart farming

However, the actual growth and proliferation of smart farming has not been as robust as was expected earlier. The sector faces several disadvantages in smart farming.

- Loss of manual employments
- Problem in adaption new technologies
- Connectivity problem in rural areas
- Non-awareness of the varying farm production functions
- Small size of individual land management
- Challenge for indoor farming
- Technical failures and resultant damages
- Benefits not immediately apparent

Conclusion

The population are increasing day by day at an alarming rate of growth and agricultural lands are utilized for construction of residential building, bridges, road, railway track and establishment of industries. Food production must increase by 70% in the year 2050 in order to meet our estimated world population of 9.6 billion people. Land usage has mostly reached its limit – by now, it's clear that the key is not using more land, it's how we grow our crops that has to change. Smart farming has become not only an option for the future, it's becoming a necessity. So, the main aim of smart agriculture is to obtain maximum production per unit area and per unit time.





FARMER PRODUCER ORGANISATION (FPO) IN THE DAIRY SECTOR

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Introduction

Farmers Producers Organization (FPO) is an association of farmer-producers that assist small farmers with end-to-end services comprising nearly all aspects of dairy from input to technical service, processing, and marketing. The idea behind the FPO is to form organizations of the dairy farmers and enrolled under the Indian Companies Act, 1956. So, the Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India formed the Small Farmers Agribusiness Consortium (SFAC) to help the State

Governments in the formation of FPO. The concept of FPO is recommended by Yoginder K Alagh committee. FPOs/FPCs can register on e-NAM Portal via website (www.enam.gov.in) or mobile app or providing required details at nearest e-NAM mandi.

FPO

Significance of FPO

- To share the resources.
- Better focus on inputs and technology.
- Better bargaining strength

in the market.

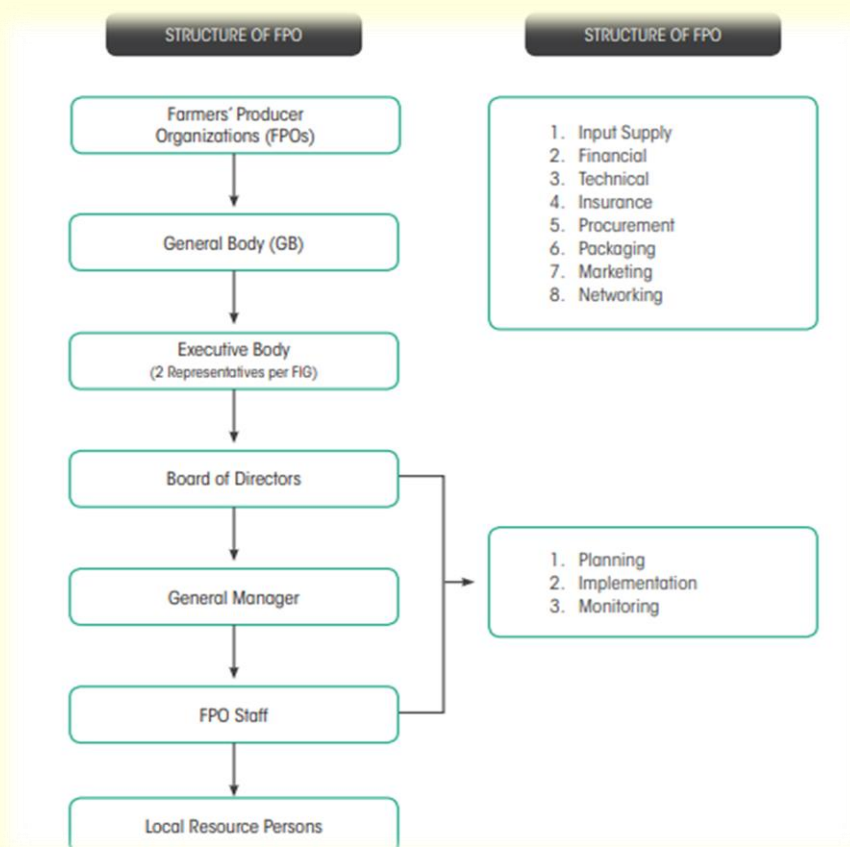
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Service model of FPO

- To ensure better income for the producers.
- Create value addition across primary processing, storage, secondary processing, and market linkages.
- To eliminate the inefficiencies related to the cooperative sector e.g. lack of transparency, political interference, and corruption, etc.
- Create a stable market platform for dairy farmers
- To create employment opportunities in the rural sector.
- Women empowerment.

- Restriction on non-producer to invest in FPO.
- It is difficult to start in rural areas due to the requirement of minimum capital of Rs. 1 Lakh.
- Lack of availability of qualified professional managers.
- Lack of access to credit and technology.
- Lack of awareness among dairy producers.


Government efforts:

- Supporting Dairy Cooperatives and Farmer Producer Organizations (SDCFPO) is a Central Sector Scheme initiated under Dairy Processing and Infrastructure Development Fund through NABARD. The aim is to provide a stable market platform by creating the necessary infrastructure for the milk producers and distributors to gain access to the organized milk sectors.
- Cabinet Committee on Economic Affairs approved the formation of 10,000 FPO.
- Follow the model of Kuzhumai FPO and Vegetable Grower Association of India (VGAI) organize FPO in Ambala district and started the LAVERA project.

Challenges associated with FPO

- Small livestock holders do not have much of the capacity to contribute a large amount of share capital.





MODULARIZED INSTRUCTIONS: FUNDAMENTALS AND PROCESS



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Modularized Instructions is either partly or entirely based on modules. It was first introduced by American Educators and described by *John L. Hughes*, (1962) as an individualized instruction that provides bases for close interaction between the learners and subject matter. With the modules, the learners are expected to respond frequently in the interaction with an instructional program at their learning rate. It is one of the most widespread and recognized teaching learning technique in many countries. It is used in almost all subjects like natural science, especially in biology and medical education and even in social sciences as well as in computers education. All kinds of

subjects are being taught through modules. It is considering the individual differences among the learners which necessitate the planning for adoption of the most appropriate teaching techniques in order to help the individual grow and develop at her/his own pace.

What is Module?

According to Russel (1974) an instructional package dealing with a single conceptual unit of subject matter. Module is a unit of work in a course of instruction that is virtually self-contained. An independent unit of a planned series of learning activities designed to help the student to accomplish certain well-defined objectives. It is a curriculum package intended for self- study. It is an auto-tutorial.

Characteristics of Module:

Module have many characteristics such as Independent, self-contained, self-instructional, well defined, clearly defined objectives, concern individual differences, association, structure sequence of knowledge, systematically organized learning opportunities, active participation by learner, Immediate reinforcement of responses, Evaluation of the work.



Essential Components

1. Rationale: An overview of the content of module and explanation of why the learner should study it.

2. Objectives: What is expected outcome of module? This is stated in behavioral/ performance terms.

3. Entry Test: To determine if the learner has prerequisite skills needed to enter the module and check.

4. Multi Media Materials: A wide variety of media is used so learners can involve actively and utilize their senses.

5. Learning Activities: Presentation, demonstration, drill, simulation, discovery problem solving etc. may be useful. A wide variety of learning activities increase student interest and cater student needs. • **Self-Test:** This provides a chance to review and check one's own progress. • **Post Test:** To check whether the objectives attained.

Structure of Module:

- **The Title-** Title or topic is a name given to any subject of matter which represents it. In module title are given according to the subject matter Eg- Distance Learning.
- **The prologue-** Prologue or introduction is a first paragraph of any subject which have the basic information about that particular subject. In module it is a second heading under which the students are being aware by the topic. Little discussion about the topic is there.
- **The Prerequisites-** what is the prior knowledge learner should have about the topic.

- **The modular objectives-** A specific result that a person or system aims to achieve within a time frame and with available resources. In this an objective of module is stated. What are the expectations to be achieved and goals to be fulfilled?
- **The pre-module self-assessment-** Before reading the module what expected basic knowledge learners should have.
- **Various topics-** Different topics and sub-topics are given in a proper sequence.
- **Post module self-assessment-** After reading the material thoroughly, what learners have learned and understand, it is assessed by self- assessment. There is MCQ's type of questions, through which learners can assess themselves.
- **Epilogue-** At last conclusion is given about the topic and goals are mentioned about expected changes in learner's knowledge after reading the module.

Types of module

- 1- Printed module
- 2- E-module
- 3- Audio-visual module
- 4- Video module

Purpose of modularized instructions

- To allow the student to proceed at his own rate.
The belief that self-pacing is desirable & is based on two generally accepted assumptions (Burns, 1971):
 - No two learners achieve at the same rate.
 - No two learners are ready to learn at the same time.
- To allow the student to choose his own learning mode.



- Choice among different learning modes is desirable, if we assume that:
 - No two learners achieve using the same study techniques.
 - No two learners solve problems in exactly the same way.
 - No two learners possess the same repertoire of behaviors.
- Modularized structures may include a large variety of instructional activities, such as
 - reading textbooks and articles
 - examining photographs and diagrams
 - viewing films and slides
 - listening to audio-tapes
 - examining demonstration materials
 - participating in projects and experiments
 - Participating in relevant "extra curricula" activities.
- Another purpose of MI is to provide a choice among a large variety of topics within any given course or discipline, if we assume that
 - No two learners possess the same pattern of interest.
 - No two learners are motivated to achieve the same goals (Burns, 1971)."
- MI allow the student to identify his strengths and weaknesses and to "recycle" (through remedial modules, repetition, or a change in learning mode) (Klingstedt, 1971), if we assume that:
 - It is desirable to save student time (frequent evaluation permits early diagnosis).
 - It is desirable that as many students as possible, or all, achieve the stated objectives.
- Users study the modules in their own working environment.
- Users can study without disturbing the normal duties and responsibilities.
- Modules can be administered to single use, small group or large group.
- Modules are flexible so that implementation can be made by a variety of patterns.
- It is more appropriate to mature students
- It enables the learner to have a control over his learning and accept greater responsibility for learning.
- It already got wider accessibility in the present educational scenario.

Disadvantages

- Require thorough study.

Conclusion

- When we analyzing the modular method of teaching, we can understand that this is more effective amongst all.
- In recent years, the consent of modular curriculum has been under discussion in secondary schools.
- Modular approach provides more flexibility to distance teaching mode as well to learners.

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Advantages

- Learning became more effective.
- It establishes a system of assessment other than marks or grade.





ROLE OF APMC SYSTEM IN FARMER'S INCOME



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boards established by the state governments in India in order to eliminate the exploitation incidences of the farmers by the intermediaries, where they are forced to sell their produce at extremely low prices. APMCs are regulated by states through their adoption of Agriculture Produce Marketing Regulation (APMR) Act. After the independence, there were common problems of local money lenders extorting high amounts of food grains from the farmer, at throwaway prices, as interest. Therefore, considering such exploitation (like undue low prices, high marketing cost, and physical losses of the food grains) might hinder the growth of farmers, the government decided to introduce some mandatory regulations to establish market monitoring of the agricultural produce.

Introduction

The various market committees are responsible for the proper regulation of buying and selling of the agricultural produce from the farmers set up by various state governments. APMCs technically have multiple buyers, but the system of open auctions for determining prices through transparent bidding is, in practice, non-existent. In most of the APMCs, buyers have to route all purchases through middlemen, which isn't good if the direct benefit of farmers through APMCs is considered.

What is APMC?

The Agricultural Produce Market Committees (APMCs) are the marketing

APMC Model Act, 2003

The Act of 2003 included several points such as- facilitating contract farming model, giving special market to perishable produce, relaxation of licensing norms, a single market fee, allowed farmers and private persons to set up their own market, APMC revenue generation to be used for improving market infrastructure etc. But, not every state of India had passed this bill. Further, The Union



Budget 2015 proposed to create United National Agriculture Market with the help of State Government and NITI Ayog.

The model created a gap between inter-state movements of the agricultural produce. States such as Madhya Pradesh, Karnataka, Uttar Pradesh, Tamil Nadu, and Maharashtra had passed this bill then, followed by other states later.

APMC Functioning

Historically, Indian farmers have always known been exploited by middlemen as they buy their produce and sell it in the market for a higher price, thus making a profit. To avoid this, the Indian Government implemented an act called Agricultural Produce Marketing committee (APMC) Act. The act makes it mandatory for agricultural produce to be sold in the designated APMC yards. These yards are also known as “*Mandis*”. These Mandis are set up in various sizes & across different locations (*Local, district, Regional*). There must be around 4000–5000 such Mandis/yards in India.

There are basically three types of APMC yards-

1. Primary Market Yard-

This is where the farmers sell their crops while the buyers are large traders who will then transport the purchased crops/ agricultural produce and sell it to others. They are also the first point of contact with farmers, and hence, most critical.

2. Secondary Market Yard-

They are situated in semi-urban areas facilitating further trade of produce purchased from the primary market yard. This step creates opportunity for middlemen to negotiate within different states for price of produce.

3. Terminal Market Yard-

This type of yard witnesses final sale to consumers. Small traders buying produce from large traders are found in this one.

Failure of APMCs

While the APMCs were constructed in early 1960s to ensure fair transactions in farmer's income (by guaranteed MSP to farmers), in the recent times, this system deteriorated and middlemen came into the scene. The state governments put an extra APMC cess over them which became a source of extra revenue for them. Over the period of time, they increased this “**revenue**” collection and the burden was borne by farmers. The licensing of traders to operate in the market yards were meant to ensure prompt payments to farmers. Later, these commission agents took effective control and began exploiting the farmers for their own greedy deeds. The Minimum Support Price (MSP) remained in books while in reality, the traders kept their interests intact by increasing commissions. Because of these conditions, the basic infrastructure of the APMC system failed. The farmers did not benefit from them and never received the right price of their produce (Except for Punjab and Haryana where FCI buys the grains).

Conclusion

A change is need of the hour for reforms to take place. Laws to make the farmer's organization needs to be changed. FPOs should take the charge and fair practices of commodity exchange to be watched over. Any kind of constraints in front of farmers, be it geographical or political, needs to be removed as soon as possible. The condition of the market yards need to be improved and the registration should be made hassle free. A guaranteed payment method should be made online for the farmers to ensure there is no cheating happening with them again. These



marketing yards provide a platform for the commission agents to bloom. It's better to see it getting scrapped off as it is doing more bad to the farmers than it is doing well. A provision of farm services should also be set up making the farmers their priority. A significant investment in the agricultural infrastructure of the country is much needed for the kind of reforms that is needed to improve India's agriculture condition.

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PANCHGAVYA AND ITS HEALTH BENEFITS

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Introduction

Panchgavya represents five substances, milk, curd, ghee, urine, and dung, derived from the cow. Panchgavya therapy utilizes them as a medicine when there is an imbalance in Vatta, Pitta, Kapha. Indian cow breeds are bizarre in appearance and characteristics. It is generally known as "Kamdhenu" and "Gaumata" because it is a source of milk for neonates and adults.

Cow urine

Cow urine has antimicrobial and antifungal properties, which acts as an alternative to allopathic medicines. It improves

immune responses, satisfies the deficiency of elements, speeds up the wound healing process, combats antibiotic resistance bacteria. It is one of the excellent appetizers. It is used to cure cancer, AIDS, diabetes, flu, allergies, colds, arthritis, aging, etc. It limits the free radicals production thus acts as an anti-aging factor. It is effective in tonsillitis and cold. It is the best fly repellent. Gomutra chikitsa as a substitute for preventive or curative approach and documents to be more harmless as well as economical and without any side effects. Uniquely, the gomutra possesses all such chemical properties as well as potentialities of



eliminating all the harmful consequences and imbalances in the body.

Cow milk

Cow milk is consumed due to its nutritional importance and medicinal benefits. Ayurveda has defined eight types of milk collected from various animals, the dignity of the place given to cow milk. Charaka (200 BC), describes the following dashaguna (10 properties) of cow milk: “Svadu (sweet), sheeta (cold), mridu (soft), snigdha (unctuous), bahula (dense), shlakshna (smooth), pichcchil (viscous), guru (heavy), manda (slow) and prasanna (pleasing). Cow milk is suggested as an excellent alternative source of mother’s milk if children suffering from the problem of weak digestion, vomiting, and diarrhoeal episodes. It may lessen the danger of osteoporosis, colon cancer. Milk is a significant reservoir of functional peptides, possesses antioxidant, antihypertensive, antimicrobial, antiviral, antidiabetic, antithrombotic, and immunomodulation action.

Cow Dahi

Dahi is a blood purifier, Tridoshnashak, and useful in piles and gastrointestinal disorders. It is an effective probiotic, helps in controlling the infection. It checks the growth of harmful microbes in the digestive tract thus it is useful in gastrointestinal ailments. It is used to treat diarrhea.

Cow ghee

Cow ghee enhances memory, voice, vision, intelligence, and body’s resistance to infections. It possesses anti-aging factors, manifests hypocholesterolemic and immunostimulant activity, which is good for those patients suffering from the cardiovascular syndrome. It is a blood purifier, intensifies beauty. Cow ghee promotes wound healing, effective in checking and regulating paralysis and asthma. It is an active immunostimulant.

Cow dung

Cow dung occupies antiseptic and disease preventive properties. It acts as a skin toner and is used for boils and skin ashes. It is used as tooth polish to eliminate toothache. It has antiseptic and prophylactic properties. It is an excellent fly repellent. The fresh cow dung destroys the Malaria and Tuberculosis bacteria. Smoke from ashes improves the vision of a person. It kills the microorganism, and fungus causes disease, spoilage, etc. Cow dung is deemed as the best source of nutrients and microbes, which can be used as manure to improve soil quality and to get rid of pesticides. It is one of the ingredients in zero budget natural farming and organic farming.





IMPORTANCE OF WATER HARVESTING IN INDIA

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Rainwater Harvesting

Conscious collection and storage of rain water for drinking, domestic purposes and irrigation is termed as rain water harvesting. It is a process of artificially enhancing ground water recharge at a rate exceeding natural rate of recharge by putting proper structures.

Need to harvest rainwater

- To conserve surface water run-off during monsoon and to augment ground water table.
- To improve quality of ground water.
- To save energy in lifting water: 1m rise in water level saves 0.4kWh of energy.
- To reduce soil erosion.

Rain water harvesting in urban area and rural area:

Urban Area	Rural Area
Roof top rain water/run-off harvesting through	Rain water harvesting through
Recharge Pit	Gully plug
Recharge Trench	Contour bunding
Tube well	Check dam/Nala bund
Recharge well	Percolation tank
	Recharge shaft
	Dug well recharge
	Sub surface dyke (U.G.C.D)



- e. Prevention of sea water ingress in coastal areas.
- f. Decrease in choking of storm water drains and flooding of roads.
- g. To create a culture of water conservation.

Techniques for Ground water recharge in rural areas:

1. Gully Plug

Built along hilly slopes across gullies/ small streams using locally available stones, clay etc. Better selection where slope breaks so as to have some storage behind Prevents soil erosion and conserves soil moisture.

2. Contour Bund

These are suitable in low rain fall areas by constructing bunds on sloping grounds all along the contour of equal elevation Flowing water is intercepted before it attains erosive velocity by keeping suitable spacing between bunds Effective method to conserve soil moisture in watershed for long duration Spacing between two bunds depends on slope, area and permeability of soil.

3. Check Dam/Nala Bund

It is constructed across streams with gentle slopes and should have sufficient thickness of permeable bed. Water should be confined within the bank of stream. Height should not allow to exceed 1.5 to 2 m. It may be constructed with masonry/ concrete and downstream water cushion chamber required to prevent scouring.

4. Percolation tank

It should be constructed on highly fractured and weathered rocks having lateral continuity downstream with number of wells. It's a water body created by submerging highly

permeable land so that surface run-off percolates and recharges ground water storage. Normally it has storage capacity of 0.1-0.5 MCM and designed to provide water column of 3- 4.5 m. They are mostly earthen dams with masonry spillway.

5. Recharge Shaft

In rainy season, village tanks are filled up but water does not percolate due to siltation in the tanks and this water gets evaporated after few months. So, by constructing recharge shafts in tanks, this water can be recharged to ground water. It has diameter of 0.5-3.0 m having depth of 10.0 - 15.0 m depending upon the availability of water. Top of shaft is kept at half of full supply depth of tank and is filled with filter material like boulders, gravel and coarse sand. Shaft should end in more permeable strata, below the top impermeable strata. It is most efficient and cost-effective technique to recharge unconfined aquifer.

6. Dug-Well Recharge

Existing and abandoned dug wells may be utilized as recharge structure after cleaning and desilting the same. The recharge water is guided through a pipe from desilting chamber to the bottom of well or below the water level to avoid scouring of bottom and entrapment of air bubbles in the aquifer. Recharge water should be silt free and for removing the silt contents, the runoff water should pass either through a desilting chamber or filter chamber. Periodic chlorination should be done for controlling the bacteriological contaminations.

7. Sub-surface Dyke

Sub surface dyke or under-ground dam is a subsurface barrier across stream which retards the base flow and stores water upstream below



ground surface. By doing so, the water levels in upstream part of ground water dam rises saturating otherwise dry part of aquifer. The site where sub-surface dyke is proposed should have shallow impervious layer with wide valley and narrow out let. After selection of suitable site, a trench of 1-2 m wide is dug across the breadth of stream down to impermeable bed. The trench may be filled with clay or brick/concrete wall up to 0.5m below the ground level. For ensuring total imperviousness, PVC sheets or low-density polythene film can also be used to cover the cut-out dyke faces.

Since the water is stored within the aquifer, submergence of land can be avoided and land above the reservoir can be utilized even after the construction of the dam. No evaporation loss from the reservoir and no siltation in the reservoir takes place. The potential disaster like collapse of the dams can also be avoided.

Salient features of Ground water recharge techniques for urban areas:

The collection and recharge system in urban areas needs to be designed in such a way that it does not occupy large space. Rain water available from rooftop of building, paved and unpaved areas needs to be harvested. The quantum of water is comparatively small.

1. Recharge Pit

It is used to recharge shallow aquifers. In alluvial areas, where permeable rocks are at shallow depth, this technique is used. Recharge pits generally has size of 1-2 m wide and 2-3 m

deep and is filled with boulders at the bottom, gravel in between and coarse sand at the top. It is suitable for buildings having a roof area of 100 s square meters. A mesh is provided at the roof to avoid leaves/debris etc. A collection / de-silting chamber is provided at the ground to arrest finer particles entering the recharge pit. Bypass arrangement is to be provided before collection chamber to reject first showers and top layer of sand to be periodically cleaned to maintain recharge rate.

2. Recharge Trench

It is suitable for buildings having roof area of 200- 300 square meter and also for permeable strata having shallow depths. A 0.5-1.0 m wide, 1.0-1.5 m deep and 10.0-15.0 m long trenches are to be backfilled with boulders at bottom, gravel in between and graded coarse sand at top. Bypass arrangement is to be provided before collection chamber to reject water of first shower. Top of sand layer should to be periodically cleaned.

3. Tube Wells

Suitable for areas where shallow aquifers have dried up and existing tube-wells are tapping deeper aquifers. PVC pipes are connected to roof drains to collect rainwater. After rejecting rain water of first shower, subsequent rain showers are taken through a T to an online PVC filter and that filter is 1-1.2 m in length and its diameter depends on roof area. Filter is divided into 3 chambers by PVC screens. Chamber one is filled with gravels (6-10 mm), middle one with pebbles (12-20 mm) and last one with stones 20-40 mm size.



Recharge volume of widely used recharge structures:

Type of recharge structures	Recharge rate (MCM/year)
Percolation tank with recharge shaft	0.04
Check dams	0.03
Recharge wells (Up to 200m deep)	0.02
Modification of dug wells	0.001

Importance of Rain Water Harvesting

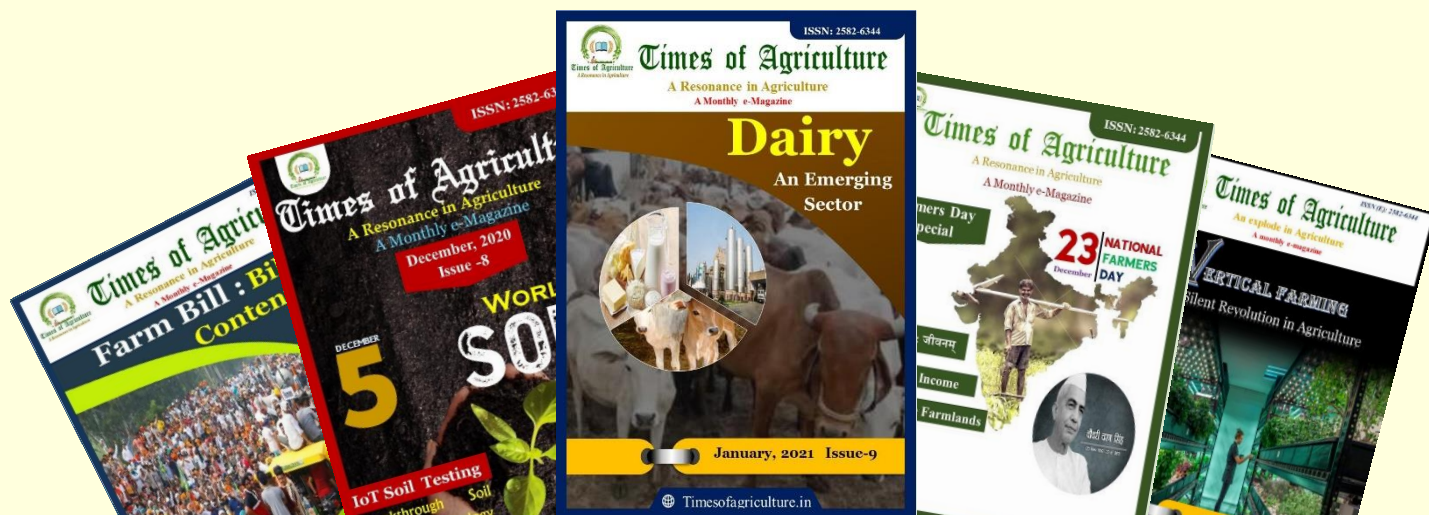
- Rain water harvesting plays an important role in Provide self-sufficiency to water supply.
- Reduces the cost for pumping of ground water.
- Provides the high quality water.
- Improves the quality of ground water through dilution when recharged.
- Reduce soil erosion & flooding in urban areas.
- The roof top water harvesting is less expensive & easy to construct, optimum and maintain.

- No land is wasted for storage purpose and no population displacement is involved.
- Ground water is not directly exposed to evaporation and pollution.
- Effects rise in ground water levels.
- Mitigates effects of drought.
- Reduces the runoff
- Helps in reducing water and electricity bills
- Environment friendly
- It is important to save the water for the future.

Conclusion

‘Rainwater harvesting’ is usually taken to mean the immediate collection of rainwater running off surfaces upon which it has fallen directly. So, collecting rain water is cost effective and a best alternative to the scarcity for water worldwide. Therefore rain water harvesting should be improved to gain sustainability in various aspects in rural as well as in urban areas. .





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