Water Classroom 3-2(1) (version 2)

Water in Agriculture - part 1

Teaching plan for learning on water for middle school students

Under a project initiated by the Living Waters Museum, Centre for Water Research, IISER Pune and Research and supported by Transforming Education for Sustainable Futures, IIHS, Bangalore

3-2(1)-1 Proposed plan

Lesson Plan number	WC-3-2(1)
Topic	Water in Agriculture
Discipline	Science, social studies
Time	120 minutes (can be divided into multiple sessions)
Prior learning	important food crops, cropping seasons, virtual water (Module 1, topic WC-1-4), water and gender (Module 2, topic 2-3)
Learning objectives	● Students *identify* and *discuss* the importance of water in agriculture in determining quality of life, especially the quality of life of rural women. ● Students *compare* the water holding capacity of different soil types based on grain size ● Students *recognise* important subsistence and cash crops in India based on their cropping seasons ● Students *determine* the water requirements of important crops, and the preferred soil type
Learning outcomes	● Students *defend* and *negotiate* a position they take on the importance of water in agriculture in determining quality of

	life, especially of rural women ● Students *predict* the water holding capacity of different soil types based on grain size ● Students *match* important subsistence and cash crops in India with their cropping seasons ● Students *differentiate* which subsistence and cash crops sown in different cropping seasons have a higher/ lower water requirement, and which soil type they are suited to
Resources/materials	A reference powerpoint presentation is appended: WC-3-2-1-ppt-Water and Agriculture Activity WC-3-2(1)-Activity-I ● 8 pairs of cards X 7 sets with the matching statistics and statements about agriculture, water use, and women's participation in agriculture ● Slide with answers Activity WC-3-2(1)-Activity-II ● 4 statement cards about an important productive resource that women farmers do not have equal access to, compared to men farmers ● Slide explaining the root cause of women farmers not having the same access to productive resources compared to men. Activity WC-3-2(1)-Activity-III ● Different types of soil which have been dried out in an oven overnight (clayey, clayey loam, loam, sandy loam, sandy, silty)

	• Weighing scale • spatula • water • Small paper cups or pots with a hole in the bottom • Water collection cups • 10 ml and 25 ml measuring cylinders X 7 • Worksheet with table and questions
Use of teaching time	**5 mins** Facilitator/educator will introduce the session including the following opening remarks – -India draws more groundwater than China and the USA combined. -Studies show that India uses 4 X the amount of water per kg of crop harvested compared to China and Brazil (Source: https://timesofindia.indiatimes.com/readersblog/the-wanderer/the-sinking-water-29467/) *Refer to – appended file WC-3-2-1-ppt-Water and agriculture* **2-3 mins** Facilitator introduces the topic of water and agriculture by asking the following- -Do you think it is important to know something about agriculture and farmers in India -Are farmers in India mostly men or women? Pick a few random students to answer. Then divide students into table groups (7 nos). **10-12 mins**

	Facilitator/educator will conduct activity - WC-3-2-1-Activity-I Hand out cards with the statistics and statements. Ask groups to discuss within their group and match statistics (%s) cards with statement cards. Share slide(s) showing the actual matches between statistics and statements. Get each group to announce their answers. Discuss whether these statistics make students feel like it's important to know something about this topic on women in agriculture. Which statistic struck them the most? *Refer to – Background content for facilitator/educator – section 3-2(1)-2a* **15-20 mins** Facilitator/educator will conduct the activity – WC-3-2(1)-Activity-II This activity is designed to allow students to select and discuss which resources should women farmers have equal access to as men farmers. This activity requires students to move around in the room. *Refer to – Background content for facilitator/educator – section 3-2(1)-2a.* **40 mins** Facilitator/educator will divide students into 7 groups and help

	them to carry out the experiment to estimate water holding capacity of different soils – WC-3-2(1)-Activity-III. Facilitator/educator will do a brief demonstration of the procedure to be followed. They will hand out a sheet of written instructions to each group. They will ask group to read though the instructions. Facilitator/educator will then ask each group a question about one of the steps of the experiment in turn. Each group will be given 30 mins to carry out the experiment. *Refer to –* *-WC-3-2(1)-Activity-III* *-appended file WC-3-2-1-ppt-Water and agriculture* *-Video demonstration –* https://www.google.com/search?q=soil+water+retention+capacity+experiment&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:5a0efdc7,vid:ojCRX6ILzRY **15-20 mins** Facilitator/educator will give each group 10-15 minutes to complete a worksheet with data table, and answer questions about which crops would be appropriate for each type of soil. Facilitator/educator may explain the tables for cropping seasons, crops and soils using slides. Worksheet is appended as file - WC-3-2-1-worksheet-Water-holding-capacity *Refer to –*

	-Background content for facilitator/educator – section 3-2(1)-2b-c *-WC-3-2-1-worksheet-Water-holding-capacity* **15-20 mins** Facilitator/educator will randomly pick students from every group to share their findings from the worksheet. The facilitator/educator wraps up by filling in any gaps or confusion. If time permits, facilitator/educator may have additional discussion. *Refer to - Additional activities*
Differentiation	Extra scaffolding for individual students based on the age group and level of your class.
Additional activities	Read and summarize main points. Write down 3 points that you learned from this article? https://www.oxfamindia.org/women-empowerment-india-farmers Research changing water requirements of the same crop for different soil types. Research changing water requirements at different stages of crop-growth, flowering, fruiting. 1. Optional discussion questions (can be assigned as homework or extension) : 2. Based on what you have learned so far, which crops do you think would grow well in sandy soil? Clayey soil? 3. (Water retaining one is good for water intensive crops like rice. Moisture rich soils are used for other water intensive crops.) 4. Will a particular crop require the same quantity/ amount of

	water if you grow it in sandy soil and clayey soil? Why or why not? How does the water requirement of a particular crop change based on soil type? (A particular crop will require different quantity/ amount of water if the soil is not of good quality - water retention will be less so frequent watering will be required) 5. Can soils with the same amount of water retention give different crop yields? (Yes, the amount of minerals and nutrients present [soil fertility] can make a difference.) Can our food choices be aligned to the season, soil in area that we live in or any other factors? Do you know about modern ways of farming? Can one grow plants without soil? Yes, people are trying this new way of farming called hydroponics, where seeds are not sown in the traditional way. Instead of soil layer, different supporting materials are used and the required nutrients are added to the supporting material from outside. Here are the links that can help you understand all this better. https://www.verticalroots.com/the-what-and-why-of-hydroponic-farming/ Hydroponics in India
Anticipated challenges and solutions	Time constraints. In WC-3-2(1)-Activity-III, it is important that the soil is oven-dried. In case the experiment does not work for some students, facilitator/educator can discuss the role of failure in science and experimentation and how to deal with the frustration or

	disappointment that may follow.
Keywords	Cropping seasons, kharif, rabi, summer, yearly; Water sources, surface water, dam, percolation tank, groundwater, well, borewells; Soil types, sandy soil, clayey soil, loam soil, black soil, red soil, groundwater extraction, saline ingress, cash crops, fertile soil

3-2(1)-2 Background content for the facilitator/educator:

3-2(1)-2a Indian agriculture and women farmers

Excerpt taken from: **'Sector- wise GDP of India'**

https://statisticstimes.com/economy/country/india-gdp-sectorwise.php#:~:text=Sector%2Dwise%20GDP%20of%20India&text=The%20services%20sector%20accounts%20for,and%20allied%20sector%20share%2020.19%25.

The services sector is the largest sector of India. Gross Value Added (GVA) at current prices for the services sector is estimated at 96.54 lakh crore INR in 2020-21. The services sector accounts for 53.89% of total India's GVA of 179.15 lakh crore Indian rupees. With GVA of Rs. 46.44 lakh crore, the Industry sector contributes 25.92%. ***While agriculture and allied sector share 20.19%***...

…***The Agriculture sector's contribution to the Indian economy is much higher than the world's average (6.4%)***. The industry and services sector's contribution is lower than the world's average 30% for the Industry sector and 63% for the Services sector.

Excerpt taken from: **'Empowering India's Women Farmers: Bridge the Gap'**

https://www.hindustantimes.com/ht-insight/economy/empowering-india-s-women-farmers-bridge-the-gap-101647511783243.html

Women's continued role in agriculture is well marked, well realised, however, it is often underestimated. Close to 75% of the full-time workers on Indian farms are women. Agriculture, one of the largest contributors to India's Gross Domestic Product (GDP) and a driving force for the country's economic development, relies heavily on women employing the largest number of women in India. Women's continued role in agriculture is well marked, well realised, however, it is often underestimated. Close to 75% of the full-time workers on Indian farms are women.

In rural India, the percentage of women who depend on agriculture for their livelihood is as high as 84%. India's livestock sector, which is the world's largest livestock production systems--over 70% livestock work is done by women. Women's participation rate in the agricultural sectors is about 47% in tea plantations; around 47% in cotton cultivation; 45% growing oil seeds, and 39% in vegetable production.

Despite their large presence and their contribution, women farmers, often, are not equipped with what they need to succeed in farming. Studies have shown that women have less access to inputs (seeds, fertiliser, labour, and finance), critical services (training, insurance) and organised markets when compared to their male counterparts.

This inequality comes with a social and economic cost. Research has consistently shown that inequity in access to resources impacts both the economic well-being of women farmers as well as overall agricultural output of the country. The Food and Agriculture Organisation of the United Nations estimates that if women were to have the same access to productive resources as men, they would increase the yields on their farms by 20-30% and this would end up adding at least 2.5–4% to the total agricultural output in developing countries. Similar inequalities are evident in price realisation where in view of unequal access to formal markets, women often realise less price for their produce than their men counterparts…

Excerpt taken from **'The Invisibility of Gender in Indian Agriculture'**
https://www.downtoearth.org.in/blog/agriculture/the-invisibility-of-gender-in-indian-agriculture-63290

Over 40,000 farmers had gathered in Delhi from across India on November 20, 2018. Forty-year-old Chandravati from Ghazipur district, Uttar Pradesh, left three of her daughters and a son back in her village to participate in the Kisan Mukti March at the Ram Lila Maidan, forgoing a Rs 120 per day wage rate. Accompanied by her husband and neighbour Manju (35), she, along with 40 other women from her village and adjoining districts, joined the peaceful congregation in the anticipation of being heard by those at the helm of policy making.

Just like Chandravati and Manju, Ramrati Devi (70) and Sumitra Devi (55) endured a 30-hour plus journey from Masauri village in Patna, Bihar. Their demands were simple: to obtain a fair compensation for the paddy crop that got spoilt in 2018, so as to sustain livelihoods…

…Recent farmer protests have seen a historical trend emerging — that of, participation of the female labourer, the woman farmer, the farm widow, and the consequent visibility of the hitherto invisible 'gendered' problem in agriculture…

Conspicuous by 'her' absence

Globally more than 400 million women engage in farm work, although they lack equal rights in land ownership in more than 90 countries. Women worldwide engage in non-mechanised farm occupations that include sowing, winnowing, harvesting, and other forms of labour-intensive processes such as rice transplantation.

According to Oxfam (2013), around 80 per cent of farm work is undertaken by women in India. However, they own only 13 per cent of the land…

…Women in agriculture are affected by issues of recognition and in the absence of land rights, female agricultural labourers, farm widows, and tenant farmers are left bereft of recognition as farmers, and the consequent entitlements.

The root of the problem begins at the official lack of recognition of the female agricultural worker, and the resultant exclusion from rights and entitlements, such as institutional credit, pension, irrigation sources, etc. According to the India Human Development Survey (IHDS, 2018), 83 per cent of agricultural land in the country is inherited by male members of the family and less than two per cent by their female counterparts.

In the absence of any recognition, women such as Chandravati, Manju, Ramrati Devi, and Sumitra Devi are left out of entitlements related to access to rural credit, assets, technology, ***irrigation***, and inputs…

3-2(1)-2b Crops and cropping seasons

Around 85% of net water usage in India is used for agriculture. Different crops are sown at different times in the year. Monsoon crops are dependent on rainfall for their water requirements. Winter and summer crops are only possible if and only if other water sources are available. Educators can discuss the categories of crops based on the season in which the crops are present in the farms.

Season	Monsoon	Winter	Summer	Yearly
Sowing time	A week after rain begins	After the monsoon, generally in the month of November#	Around March	In the beginning of monsoon
Harvest time	3-4 months after sowing (varies from crop to crop)*	February to March (changes according to crops)	Around May	10-11 months after sowing **
Water source	Rainwater	Surface water storage like farmponds, check dams, canals / groundwater through borewells, dug wells,		

Crops sown	Cotton, rice, soybean, Tur, maize, ragi	Wheat, jowar, gram, soybean	Pulses like moong and vegetables like tomato, eggplant (baingan)	Turmeric (haldi), potato, fruit like banana, papaya, sugarcane

*cotton can be kept for a longer time as it can grow flowers multiple times. If water is available or enough soil moisture is present farmers harvest cotton twice or thrice. In that case harvest time is 1-2 months after the regular harvest time.

#Wheat is sown in December as it requires cold weather.

** for horticulture trees are always present i.e. water is required throughout a year

3-2(1)-2c Water requirements are different for different crops

Seasons	Monsoon	Winter	Summer	yearly
Water intensive	Rice, cotton	wheat	Vegetables, pulses	Sugarcane, turmeric, fruits
Less water intensive	Ragi, Tur	Jowar, bajra, gram		potato

Why do different crops/ plants require different amounts of water?

Water requirements depend upon different evapotranspiration rates depending upon the chemical reactions going on in the cells of the plants. The reactions depend upon the type and amount of the product that is being produced. (For higher grade students, functioning of stomata and chemical reaction of photosynthesis could be explained.)

Change in water requirement at different stages of growth

Water requirements are different at different stages in the life cycle of the crop. More water is required at flowering stage and pod formation. Missing watering at this stage leads to significant change in the crop yield and it further affects the net product. Also note that farmers cut the water supply for a couple of weeks to kickstart the flowering stage.

Effect of soil type and depth on water requirement

Is it possible to grow any crop anywhere? Why do we see different crops in different locations? Soil type and climate contribute to these choices. The water holding capacity of the soil and water requirement of the crop needs to match for a proper growth of the plant. The depth of the soil layer should be suitable for root growth. Soils that are too shallow are not good for farming.

3-2(1)-2d Irrigation practices

In non-monsoon seasons, farmlands need to be irrigated using water available in the dams or wells. Check dams, canals, percolation tanks are the surface water storages. Borewells and dugwells are the groundwater storage structures used for irrigation.

Water storage structures used in irrigation in non-monsoon months. (Clockwise from top left) Check dam, canal, borewell, dugwell

Traditional practices - Farms were irrigated from the canal or well water through furrows made in the farm. Bullocks were used to extract water from wells.

Furrows used for irrigation

New/ non-traditional practices - nowadays water is fetched from sources using a pump. Instead of watering through furrows, sprinklers or drip irrigation is used.

Non traditional practices of irrigation include sprinklers (left) and drip irrigation (right)

Water Classroom WC-3-2(1)-ACTIVITY-I

Agriculture and water

Prepare two sets of cards:

1. With statements given below about agriculture, water use, and women's participation in agriculture

2. With percentages as given along with the statements below

a) Gross Value Added by agriculture to the Indian economy **(20.2%)**
b) Gross Value Added by agriculture to the world economy **(6.4%)**
c) % of total water use that is used for agriculture in India **(85%)**
d) % of groundwater used in India compared to the combined total of groundwater used by China and the USA **(>100%)**
e) % of water used per kg of crop harvested in India compared to China and Brazil **(400 %)**
f) % of women engaged in agriculture in India **(85%)**
g) % of women who own the land they are farming **(13%)**
h) "% increase in the yields on their farms, if women were to have equal access to the things they need as men do **(20-30%)**

Hand out cards with the statistics and statements. Ask groups to discuss within their group and match statistics (%s) cards with statement cards.

Share slide(s) showing the actual matches between statistics and statements.

Get each group to announce their answers. Discuss whether these statistics make students feel like it's important to know something about this topic. Which statistic struck them the most?

Water Classroom WC-3-2(1)-ACTIVITY-II

Agriculture, water and women

-On A3 paper, print out 4 different statements- each about an important productive resource that women farmers do not have equal access to, compared to men farmers.

1. seeds, fertiliser, water for irrigation, labour, loans from banks, crop insurance
2. ownership of land in your name
3. opportunities to learn modern methods of farming that need less resources (like water), less money, and grow more crop
4. markets where you can earn a decent profit

-Tape one in each corner of the room. Read them out.
-Each student chooses what they think is the most important productive resource that women farmers do not have equal access to compared to men farmers, and go and stand in that corner.
-Then each group discuss their reasons for choosing that resource and choose one boy and one girl spokesperson to represent them to the audience.
-Each pair of spokespersons has 2 minutes to present their arguments in favour of their position and try to convince others to join them.
-Students are then given the opportunity to cross over to another group if they change their minds about what is most important.
-FInally, each group discuss and present the root cause of women farmers not having the same access to productive resources compared to men. The facilitator listens and adds in points if required to conclude the discussion with a slide

Water Classroom WC-3-2(1)-ACTIVITY-III

Water holding capacity of soils

Aim: To understand the water holding capacity of different soil types based on grain size

Materials: soil samples, water, Small cups/pots with a hole in the bottom, water collection cups/pote, measuring cylinders, timer

To do:

1) Weigh equal amounts of soil in separate cups/pots
2) Dry soil samples in an oven overnight
3) Observe the soil and note down the colour and grain size (fine clay, gravel, sandy, gravel+sandy, gravel+clay, loam)
4) Make sure that the holes at the bottom of the cups are equal in size
5) Keep measuring cylinder/ another cup below the hole
6) Put equal amount of water in all soil samples
7) Measure the amount of water coming out of the soil in 10 mins
8) Make a note of the amount of water that comes out of each soil type you are working with in the worksheet provided.