Agricultural Water Demand in West Bengal

Report from Grassroots Field Exposure Session - December 2018

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INDIA-UK
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भारत-ब्रिटेन जल कें द्र एमओईएस-एनईसीआरसी(यूके) जल सुरक्षा अनुसंधान के पूरक प्राथमिकताओ के बीच सहयोग और सहयोग को बढ़ावा देने के लिए करना है

Front cover image: A water pond, a primary source of water used on Gosaba Island. D. Joshi.

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Executive Summary

Agriculture is an important aspect of livelihood development in India. Increasing area under agriculture, coupled with changing cropping patterns has led to overarching demand for water for irrigation. Unregulated and inefficient development of water resources for agriculture is resulting in overexploitation of water resources and growing water stress. This is leading to increasing vulnerability of local communities in terms of year-round water security and water quality, and the availability of clean drinking water in particular. In this context, a Grassroot Field Exposure Session (GFES) was organized in the Sundarbans region of the state of West Bengal by IUKWC from 10th to 12th December 2018. Scientist and researchers from various academic, non-government and research agencies from India and UK participated in the session, which was a unique approach to understand the emerging issues in field. The participants engaged in dialogue with stakeholders and through field observations arrived at key research agendas for improving knowledge and understanding of the situation in the region. This report outlines the key activities, learning and outcomes of the GFES event.

The boat and the mangroves form the identity of the Sundarban regions often highlighting the vulnerability of the region in terms of climate change induced threats to ecosystem and livelihoods (Dhaval Joshi)

1. Activity Leads

The Grassroots Field Exposure Session (GFES) was convened by the India-UK Water Centre (IUKWC) and led by the Activity Leads:

Dr Lalu Das

Technical Lead

Bidhan Chandra Krishi Vidyalaya

Kolkata, West Bengal

Email: daslalu@yahoo.co.in

Dhaval Joshi

Stakeholder Lead

Advanced Center for Water Resources Development and Management

Pune, Maharashtra

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The GFES was held in the Gosaba block of the 24 South Parganas South district and in Korakati Gram Panchayat, which is part of Sandeshkhali II block, of 24 North Parganas district, between the 10th and 12th of December 2018.

The GFES was supported by local organisations including:

Government organisations: Panchayat Samiti Gosaba and Gosaba Block Development Office, and Gram Panchayat of Korakati who were involved in the event and participated in discussions of sharing issues and problems linked to Gosaba and Korakati water resources.

Non-government Organisations: Two non-government organizations working in the region on issues linked to livelihoods, water resources management and allied activities were involved in organizing the stakeholder meetings and field activities. They were the Tagore Society for Rural Development, who are working in Gosaba block working on issues linked to women empowerment, agricultural development etc, and organised meetings with farmers and women from the block, and PRASARI Rajarhat, who are working on groundwater management, agricultural development and water resources security in the Sundarbans regions. PRASARI organised the meetings with stakeholders in Korakati Gram Panchayat and with Gram Panchayat members of the village.

2. Activity Aims

The GFES was organized in the Sundarbans region of West Bengal to focus on agricultural water demand and allied issues and challenges that emerge therein. The activity focused on access to water for irrigation, challenges and issues in provisioning water for agriculture, the state of water resources in the region and its situation in the context of changing climate and rainfall variability.

The Sundarbans is a sensitive region and prone to various natural disasters like cyclonic activity, heavy rainfall spells, storm surges etc. In this context, it becomes important to understand the dynamics of local resource dependency, development and resultant challenges. The following are the key issues in the region:

1. Depleting groundwater levels due to increased area under irrigation/increased abstraction, development of more groundwater sources, etc.
2. Changing cropping patterns, with a shift towards cash crops and more water intensive crops. Improved varieties focus on crop productivities but not much on crop-per-drop aspect.
3. Competition between drinking and agricultural water demand, with increasing groundwater abstraction for irrigation challenging drinking water security at village level
4. Impact of water quality (especially arsenic) on food production. Arsenic is being reported across the state and with increasing dependence on groundwater and perpetual development of the resource, this issue is exacerbating
5. Impacts of climate change, with changing rainfall patterns, regional rainfall variability, increasing instances of floods, cyclones etc. leading to vulnerability of communities and livelihoods based on agriculture

The GFES activity aimed to understand these issues in the context of the Sundarbans and to stimulate thinking around the emergent research threads that need to be explored and understood to arrive at better decisions and management of water resources for agriculture in the region.

The GFES focussed on two of the five key cross-sectoral themes that guide the activity portfolio of the India-UK Water Centre. The themes were:

- Using new scientific knowledge to help stakeholders set objectives for freshwater management; and
- Transforming science into catchment management solutions.

3. Activity Participants

An open call for scientific team members was published on the IUKWC website in July 2018. The call closed at the end of August 2018, with a total of fifteen applications. From these applications eight applicants were selected (six from India and two from the UK) and a further four UK researchers who had applied to attend the second GFES were invited to join this session as well, due to overlapping interests. A total of 18 scientists participated in the activity, in addition to the UK coordinator of the IUKWC, three invited scientists from India, and the two activity leads (Table 1).

Table 1 Scientific Team

UK		
1		Prof. Harry Dixon Group Leader, Water Resource Assessment UK Centre for Ecology & Hydrology, UK; Centre Coordinator, India UK Water Centre
2		Dr Mark Everard Associate Professor, University of West England
3		Dr Alexandre Gagnon Senior lecturer, Liverpool John Moores University, UK
4		Dr Iwan Jones Research Leader, Queen Mary University of London
5		Prof. John McArthur Professor, University College London
6		Dr Andrew McKenzie British Geological Survey
7		Dr Indrani Roy Research Fellow, University of Exeter

India		
8		Dr Lalu Das Bidhan Chandra Krishi Vidyalaya, Kolkata, West Bengal; Technical Lead for GFES activity
9		Mr Dhaval Joshi Social Scientist, Advanced Center for Water Resources Development and Management, Pune, India
10		Dr Surajit Chakraborty Assistant Professor, Indian Institute of Social Welfare and Business Management , Kolkata
11		Dr Rajib Chattopadhyay Scientist D', Indian Institute OF Tropical Meteorology, Pune
12		Prof. Shiva Prasad Jayadevaiah Professor, G B Pant University of Agriculture and Technology, Uttarakhand
13		Dr Saravanan K Associate Professor, Vellore Institute of Technology, Chennai, India
14		Ms Neha Khandekar Researcher, The Energy and Resources Institute, New Delhi
15		Mr Saikat Pal Executive Director, Rajarhat PRASARI

16		Dr Gautam Saha Professor, Bidhan Chandra Krishi Vidyalaya, Kolkata, West Bengal
17		Shri. Sunil Singh PETCI NGO, Dhanbad, India
18		Dr Gautam Hirak Talukdar Scientist, Wildlife Institute of India, Dehradun
19		Dr Atul Sahai Sceintist G', Indian Institute of Tropical Meteorology, Pune; Centre Coordinator, India UK Water Centre (Unable to attend)
20		Mr Vikram Kumar Research Scholar, Indian Institute of Technology, Roorkee, India (Unable to attend)

4. Workshop Structure

The GFES session was spread over three days and it involved discussions with various stakeholders involved in the monitoring and management of water quality in Sundarbans and a concluding discussion session in Kolkata (Annex A). To facilitate discussions with the stakeholders, the scientific team shortlisted for the session was divided into four groups based on their expertise and research interests (Annex B). Each group took a lead in discussions with stakeholders relevant to their group theme and aim, to understand the current and potential uptake of scientific outputs at the ground level. Some key questions that were posited were:

- What is the nature and magnitude of the issue(s)?
- How well do we understand and assess the potential impacts?
- What management options are there for monitoring?
- What data/tools needed to provide supporting analysis options?
- What are the key research needs: data, synthesis, scenarios, support of policy?

Please see group reports (Agricultural Water Demand in West Bengal: Supplementary Information) at iukwc.org.

Figure 1: On the island of Gosaba: Field visit and meeting were held on this island while part of the Sundarbans tiger reserve can be seen south of the island (Google Maps)

Figure 2: Stakeholder interaction at Gosaba Block (Emma Bennett, IUKWC)

4.1. Improving agricultural water supply through ponds: Case of Gosaba

In the morning of the first day, 10th December, 2018, the team were taken to various farmers' fields and held roundtable meetings with a prominent women's group and farmers, as well as beneficiary stakeholders, in the Gosaba block of 24 South Parganas district, where there is heavy reliance on surface water ponds for water supply. The topics of discussion revolved around the issues in the region, challenges faced in ensuring agricultural water and drinking water security. In the second half of the day, meetings were held with the local Block Development Officials to corroborate the feedback received from communities and to further delve into the technical and management issues around water in the block.

a. Interaction with stakeholders of Gosaba island

Gosaba block is part of the 24 South Parganas district and consists of 9 islands. It comprises of 14 Gram Panchayats which have 51 Sansads (Gram Panchayat wards). Many of the islands are dependent on ponds for their daily water requirements for domestic and agricultural needs. These ponds are shallow water structures which have good quality water appropriate for irrigating agricultural crops and daily domestic water requirement. However, for drinking water, the local communities are dependent on deeper aquifer systems which comprise of good quality water. This is centrally tapped through a government scheme and supplied through stand posts across the village. In the island visited by the GFES team, it was reported that aquifers up to depth of 2000 feet are saline in nature and hence limit the development of groundwater from agricultural irrigation perspective.

Farmers are dependent on pond water for irrigating crops and due to this limitation are able to only cultivate small patches of land during winter cropping season. During the monsoon season (Kharif) rice is the predominant crop grown in the region and is sold in the local market. While understanding the rice crop varieties it was reported that the traditional Govind Bhog variety fetches good price in the local market but has low yield which limits the income while the improved CR variety has a higher yield but lesser price in the market. Following table gives a comparative picture:

Name of rice variety	Type	Yield per *bigha*[1]	Price per bag (INR)
Govind Bhog	Traditional	6-7 bags	1500
CR	Improved	9-11 bags	900

*One bag consists of 60 kg

During the post monsoon season, most of the farmers grow vegetables based on the water available in the ponds. The ponds (locally called pukur) are shallow water holding structures which harvest rain water and are used for a range of provisioning services like agricultural irrigation, fisheries, local livestock water requirements and domestic water needs like bathing, cleaning utensils, etc.

Another interesting observation during the interaction with stakeholders was the use of water filters for treating drinking water. The drinking water is supplied through a PHED developed centralized systems tapping a deep confined aquifer at 2000 feet. People collect the water via tap-posts located at relevant locations within each water of the Gram Panchayat. In one of the household the women told that we filter the water that we receive from the tap post to further ensure its safety in terms of bacteriological contamination etc. This is an emerging trend which also points to the situation of water quality and the changes therein.

[1]**Bigha: It is a traditional unit of land. In West Bengal it is usually 1/3 of an Acre.**

Figure 3: Ponds on Gosaba Island (Emma Bennett, IUKWC)

Figure 4: Pump on Gosaba Island (Emma Bennett, IUKWC)

b. Interaction with stakeholders from other islands of Gosaba block

An interaction with stakeholders from other islands of Gosaba block was organized by TSRD wherein farmers (men and women) participated in the discussion. After a thorough welcome for the GFES team, the discussions focused around issues linked to agriculture and water for agriculture. During the interaction with stakeholders from other islands of the Gosaba block, it was reported that people have started using groundwater for agricultural irrigation especially after the impact of cyclone Aila which resulted in salinization of surface water bodies. They have also started cultivating other crops apart from rice like green peas, boro rice etc. It was reported that many people experienced drying of hand pumps as the number of tube-wells (which are locally referred to as shallows) started coming up and boro rice cultivation area started increasing.

The people reported three confined aquifers which are currently been tapped: 400-450 feet layer is being tapped for irrigation purposes, the second layer of 800-1000 feet is being increasingly tapped for drinking water and the government water supply scheme taps water from 1200 feet layer.

Within a single block two distinct scenarios were observed: one completely dependent on pond water for agriculture while the other increasing tapping groundwater for the purpose. The sensitive location of the region in the Sundarbans delta region further highlights the need to address these issues which may become crucial going forward. One of the main question that emerges from these discussion is how can we ensure water security in an area experiencing increasing agricultural intensification.

Figure 5: Discussions at Gosaba Block village hall, organised by TSRD (Emma Bennett, IUKWC)

c. Interaction with government officials- Gosaba Block Development Office

A meeting was organised at the block office of Gosaba and was attended by Secretary of Panchayat Samiti and the block development officials like the Agriculture Development Assistant (ADA) etc.

The officials informed that the total area under paddy cultivation (Kharif) is 22015 Ha in the block and during the winter season boro rice cultivation is 1550 Ha. Under the Targeting Rice Fallows Area (TRFA) which aims to bring the area that is fallow after monsoon rice cultivation under irrigated agriculture, the government is trying to introduce certain crops in the area including pulses, lentils, mustard, sunflower and black gram. The idea is to increase the cropping intensity of the block. The government is also conducting the soil health programme under which any farmer can get his soil tested for the nutrient analysis and potential treatment options. Under the Pradhan Mantri Krishi Sichai Yojana (PMKSY) there is a promotion of micro irrigation techniques like drip and sprinkler irrigation. This is very critical since 8 out of 9 islands are dependent on groundwater for drinking water and irrigation and with increasing cropping intensity there will be focus on groundwater development. This may challenge the local resource sustainability with an additional impact due to climate change scenario.

The block is also implementing the Integrated Watershed Management Programme (IWMP) in two Gram Panchayats of the ward. It is focused on improving local water security through a series of interventions aimed at water harvesting, water recharge, etc.

Figure 6: Discussions at Gosaba Block Office (Emma Bennett, IUKWC)

4.2. Addressing challenges of groundwater overexploitation and ensuring livelihoods: Case of Korakati

On the second day, 11th December 2018, the team were taken to the Korakati Gram Panchayat[2] , which is part of Sandeshkhali II block of 24 North Parganas district, where they had opportunities to visit farmers and stakeholders who were more reliant on groundwater for water supply. In the first half of the day, a meeting with an NGO-supported women's group was held to share their preliminary groundwater survey data. This was followed by lively discussions on the nature of the groundwater table and soil profile. Following this, a meeting with Panchayat members was organized about the role of local governance body in mitigating and addressing the issues linked to water in the area. In the second half of the day, the team visited various sites around the block to observe the mechanisms in place for groundwater exploitation.

Figure 7: Location of Korakati Gram Panchayat: Site visits and meetings were held in Duchnikhali village and Tushkhali village of Gram Panchayat (Google Maps)

a. Interactions with Community Resource Persons

During the first half of the visit, a ward meeting was organized with men and women participating along with children. It consisted of farmers who use groundwater on a daily basis for irrigating winter crops, women who are engaged in fetching water from hand pumps and other sources for household consumption and use.

The Community Resource Persons (CRPs - also known as barefoot technicians, etc.) who are part of the community and engaged in monitoring and understanding the state of groundwater resources in their ward/GP began describing the existing situation by explaining the local resource systems through a conceptual map of aquifers and the various layers which provide water for various uses. They articulated some of the issues faced by the community especially with the advent of electrification and tube-well irrigation. The area under boro rice cultivation has increased thanks to groundwater availability but it has affected local drinking water security. Many of the farmers sell the tube-well water to other farmers and thus there is an increasing groundwater market.

[2] **Gram Panchayat: Village council**

The shallow aquifer systems are saline and hence cannot be used for irrigating crops. There have been traditional surface water systems called Khals (canals) which were used for irrigation purposes. Many of the farmers also relied on the ponds for the purpose. However, during the Aila cyclone of 2009, many of the surface water systems were destroyed and degraded beyond revival. As a result ponds in Korakati are not used for irrigation today while there has been some attempt to revive Khals for irrigation purpose but the efforts have been limited.

Figure 6: Field and discussion in Korakati (Emma Bennett, IUKWC)

b. Interactions with the Gram Panchayat at Korakati

During the second half of the day a meeting was organized with the Gram Panchayat members who discussed the issues faced by the community and the various programmes being implemented by the government to resolve the issue.

The activity ended on 12th December, 2018, with a half-day workshop in Kolkata, wherein all the participants in their respective working groups discussed their key observations and learning and then shared with the larger group the key forward linkages and potential research threads emerging from the field engagement (Supplementary Information).

5. Conclusions and Outputs

The Grassroots Field Exposure Session was an engaging event wherein scientists and researchers engaged directly with the stakeholders to understand challenges and issues on a day to day basis within the context of agriculture water demand in Sundarbans area of West Bengal. This section of the report discusses key outcomes, action points and emerging conclusions from the event.

Figure 6: On the island of Korakati, hand-pumps and tube-wells (fed through aquifers) form the predominant source of water for drinking, domestic and agricultural needs (Dhaval Joshi)

5.1. Key challenges and research questions Identified

1. A need to understand local resources

Both the locations visited as part of the GFES i.e. Gosaba and Korakati are part of a sensitive ecosystem region which is prone to natural disasters and impacts of climate change. In this context, it is crucial to understand local resource systems in greater detail and engage with the communities in devising strategies for local water resource management and agricultural water demand. For example, in case of Korakati it will be pertinent to further develop aquifer understanding and map exact recharge areas for interventions. At the same time, it is crucial to know which kind of recharge strategies can be adopted given the alluvial geological setting of the area and its proximity to coastal environment. In case of Gosaba, it should be further studies the potential role of ponds and how can their provisioning services be ensured and optimally used for agricultural purposes without impacting local ecological characteristics to ir-repairable damage. At the same time, in both the regions there is a growing threat of groundwater overexploitation for agricultural intensification. Understanding of resource systems is critical to arrive at strategies to address the emerging issues.

2. Developing agricultural interventions suited to local water resource situation

Currently, in many of the islands of Sundarbans there is an increasing area under winter rice called as boro rice which is a major driver of groundwater development and resultant exploitation. It is critical, therefore, to understand what kind of alternatives can be adopted which lead to optimum use of groundwater ensuring its sustainability and improve livelihoods for local population. With programmes like TRFA being promoted in the area it is critical that demonstration plots for potential crops and their varieties can be tried and tested in local conditions. Based on the learning from the same, ideal cropping patterns can be developed and propagated in the region, one that ensure a balance between groundwater abstraction and income sustenance. Developing

detailed understanding of local soil resource in terms of its fertility and nutrient composition will prove beneficial in this direction.

3. Ensuring drinking water security in an intensified agriculture scenario

During the field visit to Korakati it was reported that groundwater development is leading to drinking water scarcity and it burdens the women (since they are associated with the act of fetching water for family, traditionally) to fetch water from longer distances. Many a time's children too are asked to fetch water which result in loss of their school time and eventual discontinuity in learning. Since drinking water and agriculture are both dependent on the same resource system (aquifers) through different sources, it needs to be further studied how these impacts can be mitigated.

4. Reducing granularity of monitoring network and mapping

During the GFES it was reported that there is only one physical weather station of IMD located in the entire Sundarbans region. In order to understand the trends in local climate and for the changing climate it is critical that the density of meteorological monitoring is increased. Similarly there are many agencies who have satellite data for the region at a granular scale but cross sharing of data within government and non-government organizations and communities is an impediment in the smooth flow of the data and its outcomes. Additionally, in order to understand changes in local groundwater conditions, it is important that additional groundwater monitoring points are established in the region for regular data monitoring on water level fluctuation etc.

These are some of the key broader issues that needs to be further explored in the context of Sundarbans and agricultural water demand. For more details and other research issues and potential future action identified by the working groups, please see their reports here.

5.2. Conclusions and Recommendation

The activity provided a valuable insight into the very specific issues of the Sunderbans. It provided an opportunity to researchers to engage with the local people and understand their needs first-hand. It was apparent that in order to sustain livelihood development in the Sundarbans regions of West Bengal it is important to understand the surface water-groundwater- agriculture nexus. Compounded to it there are various elements like role of access to cheaper energy in local groundwater development, impact of natural disasters and climate change manifestations. Reducing vulnerability of communities and their livelihoods through designing research themes aimed at improving understanding of local conditions and implementing them through informed programmes and policies should be a forefront agenda to sustain the delicate environment of the Sundarbans.

An accompany Water Brief summarizing the key thematic points arising from the Activity can be found at www.iukwc.org

5.3. Participant feedback

At the conclusion of the Activity a feedback form was circulated to participants who were asked to provide comment on:

- the content of the event;
- the meeting venues and organisation;
- networking opportunities; and
- provide an overall score out of 10 for the workshop.

A total of fifteen respondents rated the activity an 8.8 out of 10, highlighting the ability to network with scientists from the other country, and with stakeholders and especially the opportunity to be exposed to and interact with people on the ground as the key positive. The respondents all

appreciated the level of organisation and the quality and location of the venues, despite the remote locations and the challenges therein.

Some of the areas that should be considered for improvement

- Management of travel times, which were considered too long and impinging upon the quality of engagement
- Smaller working groups, especially as there was need for translation from the local language, to ensure full participation from all the group members

"People from diverse background brought in their expertise allowing us to get a holistic outlook of problems and their potential solutions. Excellent platform for networking"

Participant feedback quote

6. Annexes

ANNEX A: Itinerary

Day 1 – 9th December 2018

Time	Agenda item
14.00 - 15.00	Registration and introductions
15.00 – 22.00	Depart for Sundarbans from IndiSmart Hotel, Kolkata for Sundarban Gateway Resort, Pakiralaya, Sundarbans

Day 2 – 10th December 2018

Time	Agenda item
09.00	Depart for field visit, Gosaba Block
10.00 – 12.00	Interaction with farmers at the Tagore Society for Rural Development office, Gosaba, followed by Lunch
12.00 – 13.00	Lunch
14.00 – 18.00	Visit to agricultural fields to observe the issues at hand / visit to Block Development Office, Gosaba
18.00	Travel back to Sundarbans Gateway Resort
19.00 – 20.00	Working Group discussions and introduction to Korakhati
20.00 – 22.00	Cultural event followed by Dinner

Day 3 – 11th December 2018

Time	Agenda item
08.00 – 12.00	Check out and depart for Korakhati, Sunderbans
12.00 – 14.00	Community meeting: Interaction and discussion with stakeholders (farmers, locals, etc.)
14.00 – 15.00	Lunch
15.30 – 16.30	Discussion with Gram Panchayat members
16.30 - 17.30	Visit to water abstraction points
17.30 – 18.30	Discussion with members of PRASARI and time for Working Group Discussions at Dhamakhali
18.30 – 21.00	Depart Dhamakhali for Kolkata, stay at IndiSmart Hotel, Kolkata

Day 4 – 12th December 2018

Time	Agenda item
10.00 – 13.00	Plenary Session with invited stakeholders, Working Group discussions
13.00 – 14.00	Lunch Working group presentations
14.00 – 15.00	Conclusions and way forward
15.00 – 15.30	Feedback and close of activity
15.30	Refreshments

ANNEX B: Working Groups

WG I	**Water resource: in context of alluvial and delta region/ monitoring availability & competition / climate scenarios/ climate vulnerability/**
Members	Vikram Kumar, Indian Institute of Technology, Roorkee Dr Saravanan K, Vellore Institute of Technology, Chennai Dr Alexander Gagnon, University of the West of Scotland Dr Gautam Saha, Bidhan Chandra Krishi Vidyalaya
WG II **Theme**	**Impacts on resource: Impacts on local water resources / mitigation / Groundwater development and resultant exploitation; challenges to drinking water security.**
Members	Prof. Shiva Prasad Jayadevaiah, G B Pant university of agriculture and technology Dr Andrew McKenzie, British Geological Survey Prof. John McArthur, University college London Dr Surajit Chakraborty, Indian Institute of Social Welfare and Business Management
WG III **Theme**	**Agriculture & Water use: use of hydro – climatic services/ crop advisories/ WEF Nexus/ Diversity in cropping patterns, crop water requirements**
Members	Dr Rajib Chattopadhyay, IITM, Pune Dr Gautam Hirak Talukdar, Wildlife Institute of India Dr Indrani Roy, University of Exeter
WG IV **Theme**	**Climate smart agriculture: Adapting climate smart agricultural practices/ Management and mitigation options in a climate change scenario**
Members	Ms Neha Khandekar, TERI Dr Mark Everard, University of West England Prof. John Iwan Jones, Queen Mary University of London Mr Saikat Pal, Prashari Mr Sunil Singh, PETCI

Back cover image: A water pond, a primary source of water used on Gosaba Island. D. Joshi.

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