Agricultural Water Demand in West Bengal: Supplementary Information

Working group reports from Grassroots Field Exposure Session - December 2018

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Group 1 & 3

Water resource in the context of delta region /monitoring availability & competition / climate scenarios / climate vulnerability AND Agriculture and water use – Diversity in cropping patterns, crop water requirements / use of hydro-climatic services / crop advisories / WEF Nexus

The purpose of the stakeholders' engagement activities was to understand the pressures on the water resources of two rural and coastal locations in the Sunderbans area of state of West Bengal: Gosaba and Korakhati, and the formulation of potential research questions on the basis of the needs identified by the stakeholders.

This report summarises the outcomes of the stakeholders' engagement activities in three main areas: issues of concern, challenges and scientific questions.

Issues of concern

Gosaba

The community of Gosaba relies mainly on surface water due to the limited availability of groundwater resources. The latter is used mostly for drinking water given the depth of the aquifer and hence the high cost of water abstraction.

A major issue of concern in relation to the water supply of Gosaba is saltwater intrusion, particularly during high tides. During the monsoon season, there are occasional breaches of river amendments leading to flooding of agricultural land with salt water, which inevitably has negative consequences on farming, the main activity supporting livelihoods in the region. A commonly mentioned example in relation to the problem of salt-water intrusion is cyclone Isla, which resulted not only in flooding of agricultural land with saltwater but also in contamination of storage ponds. Storage ponds are common in the region as they are used by residents to store water during the monsoon season to irrigate land and as a source of domestic water throughout the year. In the aftermath of cyclone Isla, the storage ponds were contaminated with salt water. As a consequence of this, livelihoods depending on agriculture could no longer be supported and this led to migration to the city of Kolkata, which lasted for two-to-three years.

Another issue of concern are changes in the onset of the annual summer monsoon. There is a perception by the community of a trend towards later occurrence of the monsoon and that its intensity is increasing. The community often faces water shortages in the March-April-May period, as the ponds that are recharged during the monsoon season dry up. During that period, groundwater is used as a source of drinking water and even bottle water for those who can afford it, while residents have to travel to larger ponds, which still have some water for their washing and bathing. A delay in the monsoon also impacts on agriculture, which depends on irrigation. However, there is also a perceived trend towards a higher intensity of the monsoon and that when it begins in the summer, the intense rainfall washes away the seeds, requiring re-seeding of the land and hence additional costs.

It was also mentioned that many ponds are poorly maintained and that there is poor distribution of the resources available from government for their maintenance. The capacity of the community to cope with the variability of the monsoon and particularly in the aftermath of a tropical cyclone is highly limited due to the prohibitive cost of insurance and the lack of resources to prepare for disasters. A lack of accessibility to markets by the community for their agricultural produce was also mentioned, and an increase in the latter would provide financial resources to better prepare for disasters. The region is also experiencing a growing population and, as a result, the land available for agriculture is decreasing due to the needs for more storage ponds. There is also

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

limited opportunity to change the variety of rice grown in the region, as the land is water logged for five months of the year, limiting the choice of crops that can withstand those conditions.

Korakhati

The island community of Korakhati is more dependent on groundwater, even for irrigating agricultural land. There are two main rice crops per year. There is no issue with regard to water availability for the first annual crop, but water availability is an issue for the second crop in the winter. The groundwater close to the surface is saline and cannot be used. There are two main freshwater aquifers, which are both relatively deep. It was mentioned that the first aquifer is drying up and that digging to the deeper aquifer is now required.

Challenges

A number of challenges were identified in the two communities. In Gosaba where the community relies on the storage of rain water during the monsoon season, the main challenge is the need for increasing the harvesting of the monsoonal rains so as to cope with an increasing population and the severe water stressed often beginning in March and lasting until the monsoonal rains begin in the summer. In addition to increasing the availability of the water resource, another challenge is protecting the water resources from salt-water intrusion. This requires improving the canal system and upgrading the sluice gates so that they allow for a unidirectional flow of water, and hence impeding the flow of saltwater landward during high tides, particularly during storms.

In Korakhati, the main challenge raised by the community is the recharge of the groundwater aquifer. The fact that they need to have deeper wells to abstract groundwater is a sign that the resource is depleting and that a water crisis is potentially coming. Another challenge in this region is the amount of water that is wasted for irrigation. There has been an increase in the number of automated well and there are currently no restrictions on the use of groundwater with the management system not encouraging conservation with a lack of technology such as micro-irrigation.

Scientific questions

A number of scientific questions were put together on the basis of the visits to the two communities. A lack of meteorological data in the region was noted and as a result of this there is a lack of a climatological study of rainfall variability. This would particularly be important for the Gosaba site, which depends on rain water, and it would be useful to put the climatic trends that the area has been experiencing into the wider geographical and longer-term context.

With regard to the community of Korakhati, which depends mainly on groundwater, there is a lack of a geological (lithological) survey. The community records the number of manual and automatic wells and the depth of the wells, but there is a need for the mapping of the aquifer and an understanding of the inputs of the aquifer, notably the identification of the location of the aquifer recharge zones. The quantification of the inputs and outputs and subsequently the use of a water balance model would allow for an understanding of how much water can be abstracted from the aquifer sustainably and also to examine the potential impacts of climate change on the water balance.

Research was also suggested on adaptive strategies to increase water storage as well as agricultural research such as potential changes in cropping patterns to reduce water stress and the use of different varieties of rice requiring less water. Research on the relationship between farming practices and water quality was also suggested, in addition to social science research on the community willingness to adapt to new technology and to new varieties of crops and cropping patterns.

Group 2

Impacts on resource: impacts on local water resources/mitigation and groundwater development

Group 2 focussed on trying to understand the primary source of water for public supply and agriculture, with a special focus on groundwater and in examining the potential for completion for resources between sectors and users.

Learning

A number of issues were highlighted during our field visits and in meetings with farmers and local officials. Many of these are not strictly groundwater focussed – a common theme was the importance of considering the problem of water resources in a livelihoods context.

1. Importance of stakeholder engagement. Although we were focussed on water supply, water quality and groundwater, it was very apparent that the problems farmers face in managing their resources were as much socio-economic as they were technical. This means that any analysis of the situation, and any actions to address problems, requires a multi-disciplinary approach, and that stakeholder engagement by professionals embedded within the community is very important. This underlies the value of engaging grass-roots NGOs (e.g. Rajarhat Prasari) in research programmes.

2. Short term stakeholder outlooks. The typical framers that we met with in both blocks had very little financial capital, and their focus was very much on the short term and managing a year at a time. This was evidenced in various ways – a fatalism in Gosaba about the likely setback that would be endured if there was another Cyclone Isla and reports of farmers in Sandeshkhali who recognised that groundwater resources are limited and under threat, but still pumped water at rates well beyond those needed to satisfy crop-water requirements.

3. The two field areas had differing approaches to agriculture/public supply conflict. This was largely mediated by local aquifer geometry. In Gosaba the shallowest aquifer with fresh ('sweet') water was at a depth of > 300 metres. It had not been tapped for irrigation, and the Block Development Office reported that they intended to reserve the aquifer for public supply through a few deep pumped-boreholes piped to communities (subsequent discussion around state policies on groundwater licencing suggest this reservation may be hard to enforce). Agricultural water and some household supplies were provided by excavated farm ponds, and villagers reported that these dried up or went brackish in the March to May dry season, when households resort to using bottled drinking water. In Sandeshkhali three aquifers have been tapped for both public supply through hand pumps, and for agricultural use. There seemed to be no effective limitation on exploitation, leading to dry season failure of hand pumps as heads drop below their suction limit (more than about 7 metres below ground level). Data was presented showing how groundwater use was increasing exponentially, and how newer wells tap deeper aquifers.

4. Issues of land ownership and tenure exacerbate livelihood pressures. Farmers in the two communities have relatively small plots of land – plots of 1/3 hectare were often mentioned. This limits their financial capital, and limits the scope for increasing surface storage because it cuts down the area of crops. Mention was made of inward migration to the islands, increasing population and pressure on resources, although this was contradicted by reports of outward migration post Cyclone Isla and of most farmers owning the land they worked.

5. Small-scale coping strategies. Boro rice cultivation using groundwater in Sandeshkhali can be seen as an innovation aimed at improving livelihoods, albeit at the expense of

water security. We were subsequently told that aquifer depletion and or salinity were leading to this crop becoming a rarer choice. We met farmers who have started to innovate in selection of rice hybrids designed for salt tolerance or in planting crops that require less water. Small-scale land sculpting, e.g. creating raised beds, was also reported.

6. At a political level, the focus is still on 'big' interventions on the supply side. When talking with local officials they commonly mentioned a need for large scale storage, 'dams'. We saw little evidence of a focus on demand reduction or improving the efficiency of water use at the field Such matters were mentioned almost in passing but not seen in practice.
7. Dependency culture amongst farmers. Farmers rarely volunteered innovative approaches to solving their water problems, but had an expectation that government intervention would be forthcoming.
8. Lack of Strategy for coping with infrequent events. The islands are bunded but the bunds lack sluice gates. Breaches of the bunds during Hurricane Isla flooded field with salty water. The lack of sluice gates in the bunds prevented rapid drainage of the land and so almost certainly allowed deep penetration into soils of salinity. Nowhere did we see evidence that this delay in draining was either appreciated or was being addressed by installation of sluice gates.
9. There are still serious gaps in technical information available at field level. The farmers, local authorities and NGO workers that we interviewed felt that they had to rely on their own knowledge for information on the soils and aquifers of their area. They felt that information that might exist in state organisations or with CGWB was not easily accessed – although it wasn't always clear whether this had been tested by actually requesting data. In Gosaba several respondents mentioned that the practical limit of excavation of ponds was just over 2 metres – and that below that the pond would be salinized. Whether this was due to intercepting a saline aquifer or a layer of sodic soil was unclear. In Sandeshkhali the farmers rely on access to deep confined groundwater – but detailed lithological logs or geophysical profiles weren't available. A key question for understanding the sustainability of these confined layers is to know whether they have lateral continuity with areas receiving modern recharge, or are isolated lenses of paleo waters. This information was not available to the communities. It was also unclear if reported increases in salinity after pumping represented lateral saline intrusion of sea water or, perhaps more likely, induced leakage of saline water from confining marine silts and clays.
10. Lack of collective action. Given the local importance of socioeconomic factors in addressing water resources problems, and the marginal incomes of many farmers, we had expected to see more evidence of collective action – whether through cooperative marketing of produce, communal rehabilitation of water supply, or sharing of croplands. It seemed that this was rare – perhaps there are larger political and social factors discouraging cooperation. It was mentioned in Sandeshkhali that a government scheme for rural income support had suspended its investment in pond cleaning activities as a result of widespread abuse and corruption.
11. Storage. In both communities the overriding water resource issue is about storage; either storage of rainwater in surface ponds or storage in the fresh portions of the aquifers. Understanding of the ways in which surface water storage can be expanded, or aquifers be exploited sustainably should be predicated on a detailed knowledge of both the physical nature of the system and the water quality.

Challenges

As in the learning, many of the identified scientific challenges cross over from the physical sciences to the socio-economic. We have concentrated on the 'supply side' challenges, with other groups focussing on the demand side issues of crop choice and efficient irrigation practices.

1. Demonstrating of the value social sciences and a holistic approach. How do we ensure that we can demonstrate the importance of the value of a holistic approach and communicate that value to research commissioners?
2. Understanding of farmer's perspectives. How can research projects that may not have a strong socio-economic component, ensure that the farmer's voice is heard? This applies equally to academic research projects and to interventions by state or federal agencies. The 'reservation' of the deep aquifer for public supply on Gosaba is an exemplar of this. The farmers and local development officials were unequivocal in their desire to preserve this resource, but it can easily be seen how outside intervention might think that developing it for agriculture would be welcome, if farmer groups weren't adequately consulted.
3. Dealing with how NGOs obtain information. The lack of detailed information on soils and aquifer geometry identified above needs to be addressed. We feel that partly this is a result of an NGO perception that state and federal agencies will place barriers to information access, which means that they rarely request data. Equally the central agencies can be bureaucratic in their approach to releasing data. Mechanisms are needed to encourage NGOs to request technical assistance and for the central agencies to recognize the wealth of detailed knowledge that is available at grassroots level. It was unfortunate that in a couple of instances we heard reports of central agencies believing their own, sparse, regional data rather than accepting that detailed local data collected by reputable NGOS would be more accurate at a local level.
4. Tools for identifying aquifer geometry at a range of scales Given that detailed information, at a scale likely to be useful at village or framer level, is sparse, how can it be collected and made available? Two particular problems are identified as challenges: a) Identifying the constraints on deepening farm ponds and maximising their depth (and hence their storage). b) Improving the understanding of aquifer lithology and associated water quality.
5. How to increase storage of fresh water? The issues of identifying aquifer geometry is the foundation for addressing the challenge of increasing water storage. The flat low-lying topography mitigates against solutions based on large scale dams – they would take up too much land area, and engineering catchments to fill large dams would be a challenge. This leaves three options: a) Increase pond storage, either by deepening the ponds or by engineering above ground storage, for instance using pumps to raise water to elevated ponds from ground level ponds. b) Reduce evaporation and or salinization of ponds. This might involve lining ponds or constructing covered cisterns for drinking water, perhaps linked to roof top rainwater harvesting. c) Recharge fresh water to aquifers. Recharge wells can be used to inject excess water during the monsoon season to the aquifer systems. However several factors would need to be considered, including the potential for contaminating the aquifers, undesired geochemical reactions if low TDS rainwater is injected and the relatively low heads available for injection, which will limit flow rates in un-pumped schemes. The practicality of using saline aquifers as part of an engineered Aquifer Storage and Recovery scheme is a particular research challenge.
6. Preparing for disaster. Individuals, NGO, and Government agencies need to combine to identify the problem posed by inadequate drainage after inundation. The installation of sluice gates in recommended and can be undertaken only at a government level.

Potential future engagement

The group considered where there might be potential for immediate short term pump priming or seed activities that would address the challenges identified within the framework of the IUKWC. In the longer term there is a clear need for large scale holistic projects that address both the social sciences and technical challenges in an integrated way, although it might be argued that these are development needs as much as research needs.

1. Tools for mapping depth of sodic soil. The depth constraint of ponds provides very real

constraints on the storage volumes of the ponds, and on how long they retain fresh water in the dry season. If the sources of salinity (or presence of sodic soils) can be better characterised, and if farmers had access to either spatial information on maximum achievable depths, or tools for estimating the safe depth prior to excavation then storage can be maximised. An increase of 0.5 metres in average pond depth might boost storage by 25%. A short project would carry out fieldwork to identify the source of shallow salinity, and test approaches to its mapping or characterisation, either using direct sampling by auger or simple geophysical tools.

2. Investigation of Aquifer Storage and Recovery into saline aquifers. While aquifer recharge is commonly practiced in India, engineered Aquifer Storage and Recovery is less common. The lack of surface storage options, fragility of the fresh water aquifers and extensive shallow saline layers makes it an appropriate technique. A pilot project would address identification of possible aquifers that could be used, numerical modelling of scheme operation, and building of a community of hydrogeologists and central agency staff that could take a pilot study forward to field scale experiments.

Group 4

Climate smart agriculture: adapting climate smart agricultural practices/ management and mitigation options in a climate change scenario

Background

Climate change is evident and is manifesting through a range of visible impacts. It is already severely impacting communities whose livelihoods are most directly dependent upon dependent on natural resources. India is largely an agrarian society wherein agriculture and the fisheries sector, especially in the climatic hotspots of the Indian Himalayan or the delta regions, are experiencing the impacts of climate change most prominently. Thus, it is important to include and improve knowledge about climate change in all aspects of resource use and development planning. The India-UK Water Centre (IUKWC) Grassroots Field Exposure Session (GFES) visit to selected Sundarbans islands was held between 10-12 December 2018 to bring together scientists researching biophysical and socio-economic aspects of agriculture-water management to discuss the climatic issues at play in the delta island villages of Sundarbans and to think of possible ways forward.

This report summarises discussions held over the 3 day period within Group IV, assigned by IUKWC with the geographical context and theme of: ‘Climate smart agriculture: Adapting climate smart agricultural practices/ Management and mitigation options in a climate change scenario.’

Study area – Salient features

The region is characterised by small-scale farmers with paddy as one of the major crops. For domestic purposes, households rely on rainwater harvesting ponds and for irrigation largely on groundwater.

Gosaba village

Gosaba village is located on Gosaba Island area in the Sundarbans delta region. Gosaba village has population of 5,369 (2,681 male, 2,688 female) based on the 2011 Population Census. In 2011, literacy rate of Gosaba village was 82.08% (87.80% male, 76.36% female).compared to 76.26 % for West Bengal state as a whole.

As per the constitution of India and under the Panchyati Raj Act, Gosaba village is administrated by a Sarpanch (Head of Village) elected as representative of the village. Schedule Caste (SC) constitutes 31.31 % while Schedule Tribe (ST) were 3.33 % of total population in Gosaba village [<==this needs explaining for non-Indians]. 62.19 % of workers describe their work as Main Work (Employment or Earning more than 6 Months) while 37.81 % were involved in Marginal activity providing livelihood for less than 6 months. Of 2,330 workers engaged in Main Work, 213 were cultivators (owner or co-owner) while 346 were Agricultural labourer. The total geographical area of village is 318.94 hectares.

The village is in the Canning subdivision of South 24 Parganas district in the Indian state of West Bengal. The habitation is close to the mangrove forests of the Sundarbans. It has a police station, a community development block, and an assembly constituency. It is one of the main deltaic islands in the Sundarban region, bounded by the Matala and Zilli rivers/ creeks. The area is subjected to human-wildlife conflict and has been subjected to tiger attack (2001-2004). The dominant source of livelihoods is farming, as well as off farm activities including honey collection. The region has patchy access to electricity.

Dhamakhali

The village falls in Sandeshkhali block II. It is located at the confluence of two rivers: Chhoto Kalagachhia and Rampur. The two rivers become the Kalagachhia River which in turn becomes the famous Raimangal after merging with river Dasha down south.

Climate change and its impacts in the region

Climate change is manifesting in various forms and impacting the livelihoods of people in this part of the coastal region of India.

The uncertainty in timing of monsoon has increased, impacting the sowing season of paddy crop. The monsoons recede later than normal, culminating in heavy rainfall that can contribute to major yield losses. Winters have also become shorter, and farmers are consequently unable to raise a second crop in the following Rabi (summer) season. Rising summer temperatures have resulted in increase in pest attack.

Field observations indicated that people are not finding agriculture to be productive anymore. As per the nature Asia article , 'between 2001 and 2008, the area under agriculture in the Indian Sundarbans had gone down from 2,149 sq km to 1,691 sq km.' Even the 'fish catch and earnings of fisheries have declined over time.'

Saline ingression was also reported to be a challenging issue impacting the livelihoods of people living in the region.

Due to increased frequency, intensity and erraticism of extreme weather events and salt water ingression phenomenon, a sizeable number of farmers are turning into migrant labours or are forced to work in the hundreds of brick kilns that have mushroomed on both sides of the border. Even off farm livelihoods like honey collection from forests suffer due to ill-managed human-wildlife conflict. Frequent storms and cyclones make agriculture a risky business in the islands. After cyclone Aila of 2009, the salinity level in the soil increased affecting the next two successive cropping seasons forcing many farmers to migrate to Kolkata and other big cities or even out of country in search of work.

The delta region otherwise has rich alluvial soil ideal for cultivation, overlaying thick clay layers separating surface water interactions from several strata of deeper aquifers exploited for drinking and irrigation water. Any changes in natural fresh surface water flow in the region due to construction of dams/ waterways is natural going to affect the flow of sediments and thus agriculture in the region.

To prevent the impacts of coastal flooding, embankments surround populated islands. However, these give rise to two sets of problems. During extreme weather events, likely to increase in frequency due to the changing climate, these structures have proved counter-productive resulting in more damage from trapped saline water when they are overtopped. They also inhibit succession in fringing mangroves, degrading their erosion regulation services and increasing scour and undercutting around the islands.

Methods

1. Guiding research questions

The objective of GFES1 Working Group IV was to assess problems associated with practices in the area and, after discussion with farmers, suggest possible measures for coping with the impacts of climate change.

Before visiting the field sites, a few research questions and pointers were formulated by the group, keeping in mind the above objective -

» What 'SMART' agriculture means to us in given context?

1. Is it finding a balance in day to day practices between traditional methods and wisdoms (water harvesting, storage and sharing, and efficient uses), adapted to the modern world and meshed sustainably with 'big technology' (pumping, dam-and–transfer, etc.) to keep water systems functional and delivering for the needs of all?
2. Does it comprise of smart choices of crops, and timing and places they are grown, to adapt to changing hydrological and other climate realities will be additional parts of our considerations?
3. Is there availability of market access to sell these crops?

» How well do we understand and assess the potential climatic impacts?

» What management options are present there for monitoring?

» What data/tools/further research is needed to provide supporting analysis options?

» What are the key research needs: data, synthesis, scenarios, support of policy?

» How do we take account of wide-scale impacts of local water management solutions, e.g. (1) does a dam in one place deny water to others including overall catchment dynamics? (2) Do local-scale water harvesting solutions impede filling of dams and other places where large-scale water is extracted? (3) How is decisions-making made about crop cycle and water-sharing between stakeholders across these different scales? (4) Can economic instruments such as PES offer win-win solutions?

» How do we build adaptive cycles into water management planning?

» Can we map power relationships in decision-making about water for agriculture, and how these can be addressed to achieve longer-term and equitable benefits?

» What are the linkages of the given context with NDCs/ SDGs?

2. Tools

For assessing the agriculture-water inter-linkages in given coupled human-environment system, following tools were used to facilitate discussions with farmers and key informants on the field –

Tools Participants/ Interviewee

In Depth Interviews, Key informant interviews

Field researcher, Prashari NGO, Gosaba

Officials at Sandeshkhali block office

Focused group discussions

With women and men farmers in Korakati GP and Gosaba block

Oral history With women and men farmers in Korakati GP and Gosaba block above 60 years of age to record changes in cropping pattern and water availability over the years

Field observations

The key observations and perspectives of farmers as well as key informants from government offices and civil society groups from the field interactions as summarised below -

4.1. Climate change trends

» Thunderstorms have become more frequent and erratic in recent times in terms of intensity.

» Rainfall has become more erratic. Onset of monsoon delayed by about 15 days or so.

» Temperature fluctuations are observed. Summers and winters have become warmer.

» Pest attack have increased.

4.2. Impacts on Agriculture

» Seed bed preparation gets affected leading to productivity losses.

» Increased salinity post Aila cyclone impacted productivity.

» Nearest market for selling harvest is Gosaba. Farmers get lower market prices. ('Half of expected/popular market price'). Men usually access markets. Both men and women participate in daily agricultural activities though.

» Lower productivity over the years has led to more agricultural intensification. Traditional varieties and culture of seed storage taken over by market forces. Use of fertilisers and pesticides has increased. As per a farmer 'government seems to be biased towards the urban areas more than our rural areas.

» Suggestions for salt-resistant varieties were sought from farmer's side. Upon further probing they mentioned that even though traditional varieties seem more resilient to them still under pressure to increase yield for income, they are forced to grow hybrid varieties, for which they have to depend on market each season.

» Discussions also revolved around exploring existing techniques to devise cropping strategies around water availability, for example reducing evaporation losses by using straws. Currently farmers are harvesting potato crops in certain areas to be able to utilise residual soil moisture post paddy crop harvest.

4.3. Impacts on Water

» There is heavy dependency on monsoonal rainfall for water requirements for agriculture and domestic purposes. Rise in irregularity in pattern is affecting water availability in the area. Especially for crops, flowering stage is a critical moment in terms of water requirement.

» Rainwater harvesting ponds have been used for domestic purposes traditionally. They have hard clay lining so do not contribute to groundwater recharge. Post cyclone, saline water had to be pumped out and fresh rain water was refilled. The existing structures are old and need repair and restoration for which they are short of labour and funds. So farmers suggested to take this up in a discussion with block office. Usage of pond mud as organic fertiliser emerged as one of the possible suggestion to close the loop in this case.

» Perceived water scarcity in lean season (March-May). Increased competition for water access around that time. Digging deeper for irrigation and reliance on bottled water are the only existing coping measures, once ponds run out of water. Women perform most water collection based activity. One of the measures suggested by farmers is large scale community water harvesting pond.

Discussions at the Block Development Office emphasised problems with groundwater trends in the area. Difficulties in tapping fresh groundwater, due to a progressive salinization of shallower strata, necessitated deeper drilling. The Block Development staff also sought to devise a mix of millet-pulses crops better suited to the area than boro paddy and other more water-intensive crops. There was a suggestion to adopt large-scale rainwater harvesting storage structure referred in discussions as ‘dam’. Boro rice has been adopted post the cyclone in the area, and vegetable crops have been abandoned. A key challenge is to sustain boro rice crop in winter which is a lean season. Transportation of crops to market was also highlighted as a challenge. In some areas, KVKs[Acronym needs to be defined] are experimenting with salt-tolerant paddy varieties but more of such suggestions were sought from scientists in terms of also the restoration of soil as well as groundwater aquifers (installation of treatment schemes). It was also mentioned that under a recent regulation, legislation now does not allow farmers to tap the deeper fresh water aquifer for irrigation purposes.

On day two of visit, trained women barefoot technicians from the area provided a decent overview of the overall groundwater profile in their area. They also explained the technique of measurement, keeping records and how they try to minimise the error. This revealed that the community was empowered to be able to communicate in an effective way about the knowledge of their region with the help of intervention of ACWADAM and Prasari NGO’s work in the area. During the discussions, it became clearer that, post cyclone Aila, maladapted cultivation practices of a water-intensive crop led to intense activity to maintain income but, lacking advisory services, this strategy proved counter-productive in increasing the existing water conflict over groundwater access in the region. Digging deeper tubewells as an end-of-pipe solution leads to overlap of ‘zone of influence’, again fuelling the competition over groundwater access.

Scientists from the visiting group suggested focusing on identification of recharge zones in the area and performing treatment using community knowledge. The representative from PRASARI NGO mentioned repeated visits to the Central Ground Water Board to support this need, but there was a lack of available maps.

4.4. Demographic trends

- Population has increased leading to land division and reduction in household level land holding.
- Out-migration has been triggered post disaster.
- Alternate sources of livelihood like weaving, poultry and production of home-made food products is encouraged by NGOs through training provided within SHGs.
- Decision-making regarding agricultural activity planning is based on equal participation from men and women
- Active presence of civil society organisations and Krishi Vigyan Kendra in the area. The Block Development office is not perceived to be easily accessible. Agro-met advisory communications are released and received on mobile sets but women are not as aware about this facility. When prompted about the watershed program, most farmers were unaware of the activities conducted within the program and how they can seek convergence.

Way forward - Scientists’ perspectives

Drawing upon systems thinking and to be able to address the UN Sustainable Development Goals to secure the well-being of the entire socio-ecological system, the scientist group felt that focus should be not only be on ‘climate smart agriculture’ but ‘climate smart livelihoods and way of life’. Based on field observations and level of participation from communities visited over the course of two days, as well as the knowledge shared by them of the natural resources in the area, the scientist group arrived at the conclusion that residents have done a decent problem analysis and can share explain the priority issues well. Based on this, few research questions were suggested:

a. Can we innovate effective knowledge-sharing networks (community-scientists; community-policy makers; community-government; within different ethnic groups, Panchayat Raj institutions (PRIs) and men and women)

b. Can we suggest ways to enhance acceptability of new crops, drip irrigation, markets, etc.?

c. Outmigration (14-55 males) post-Aila seemed to be prominent. A research question to ask here is: How can we increase overall livelihood resilience in the area?

d. There are missing links in terms of understanding of supply-demand, need, availability of surface as well as groundwater hydro-geology in the area; especially in term of the dynamics of replenishment of groundwater, which is not understood well. Work starts with identifying, demarcating and protecting the recharge zones relevant to the area, some of which may be local but others replenishing the deeper aquifers may be remote. Besides, there seems to be a need to improve efficiency of surface water usage (for both agriculture and domestic purposes). How much is the requirement for storage? Can LIDAR or other methods to estimate surface storage capacity? Based on these estimations, can we work out necessary capacities for safe Agors (small catchments for recharge) supporting annual water needs? Can Underground storage of (roof) water be explored for safe domestic use?

e. Water quality is an additional and perceived lower priority issue relative to water quantity. Sanitation and nature based solutions (e.g. artificially constructed wetlands or channelizing existing wetlands) solutions for water safety are required.

f. Once water availability in the area is well understood, the cropping strategies can be devised based on the water regime in the area. Other points to keep in mind for climate smart agriculture are:

   I. What alternative Boro (second) crops are more water-efficient?

   II. What are the water wise crops that can be grown, so that one does not end up exporting virtual water (watermelons for example)?

   III. The hydro-climatic services need to incorporate the differential water availability. Are communications designed keeping users in mind/ discussing prior to them?

g. Disaster risk reduction and building resilience gradually also needs attention, given the area is prone to coastal area flooding and heavy winds during cyclones. The hard solutions adopted presently like concretisation of bunds is leading to mangrove loss as well as increasing erosion. How do we bring in eco-hydrological wisdom into erosion control? Can we attempt systemic valuation of mangroves (e.g. accretion, fisheries, honey, etc.)?

h. May be there is a need for adapting property rights to a dynamic landscape (land compensation).

Overall there is a need for ecosystem-based approaches as a basis for resilience across overlapping interest and policy areas such as farming, flooding, and coastal defence and livelihood resources. We need to motivate and engage state agencies such as the Central Ground Water Board, Geological Survey of India, etc. to address significant data gaps. However, some useful data are available but scattered (land use patterns, etc.), so there is a need to audit and collate what is available. Participatory mapping can be effective in addressing small-scale data. Crowd-sourcing is cost effective and saves time. This can support local-scale cost-benefit demonstrations. More of action research is required in collaboration with farmers/communities, responding to their needs and with an adaptive approach based on ‘what works’ also serving as a powerful means for outreach and dissemination.

CITATION

Joshi, D. & L. Das (2019).

Agricultural Water Demand in West Bengal: Supplementary Information. Working group reports from Grassroots Field Exposure Session - December 2018. The India-UK Water Centre; UK Centre for Ecology & Hydrology, Wallingford and Indian Institute of Tropical Meteorology, Pune.

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

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