IC/IR/2002/13
INTERNAL REPORT
(Limited Distribution)

United Nations Educational Scientific and Cultural Organization
and
International Atomic Energy Agency

THE ABDUS SALAM INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS

STRATEGIES FOR RESOURCE MANAGEMENT TO IMPROVE AGRICULTURAL PRODUCTIVITY IN BARIARPUR TAL AREA OF BIHAR (INDIA)

A.R. Khan[1]
Land, Water, Environment & Engineering Research Programme,
ICAR Research Complex for Eastern Region,
Walmi Complex, P.O. - Phulwari Sharif, Patna - 801 505, India
and
The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy,

A. Upadhyaya, P.R. Bhatnagar, U.S. Gautam, S.K. Singh and S.R. Singh[2]
Land, Water, Environment & Engineering Research Programme,
ICAR Research Complex for Eastern Region,
Walmi Complex, P.O. - Phulwari Sharif, Patna - 801 505, India.

MIRAMARE - TRIESTE

June 2002

[1] Regular Associate of the Abdus Salam ICTP.
[2] Vice Chancellor, Rajendra Agricultural University, Pusa, Samastipur, Bihar - 848 125, India.

Abstract

Water logged Tal area is termed as the stretch of land having bowl shaped depressions inundated in monsoon season due to spill / overflow from rivers or runoff from upstream end. A team of Agricultural Scientists studied and suggested a suitable plan to the Ministry of Agriculture, Government of India for improving the agricultural productivity of 40,000 hectares land lying between Ghoraghat and Bariarpur and Prasando to Khand Bihari in Munger district of Bihar, which lies in eastern India. These lands remain inundated with water from July till January. Tal lands in Bariarpur suffer due to stagnation of water during monsoon period and delay in drainage thereafter. This is a late winter mono-cropped area with very low productivity. Though the fertility status of soil is good, the quantity and quality of produce is poor. The canal network is also not efficient and other parts face drought. It is expected that the Ministry of Agriculture, Government of India will take up the action plan as per the recommendations of expert scientists' team to mitigate the sufferings and misery of the farmers and rural population of the area. The team of scientists had investigated in detail the genesis of the problem and suggested the appropriate management strategies to improve the agricultural production in this area upon the instruction of the Hon'ble Union Agricultural Minister Mr. Nitish Kumar. A reputed Journalist and dedicated Social Worker Mr. Dinesh brought the unbelievable misery of the rural population to the attention of the Agricultural Minister. The sufferings of the farmers of Bariarpur tal area thus cannot be mitigated without the implementation of recommendations suggested in the scientific report. It seems that a financial crunch is coming in the way for such implementation. Ministry of Agriculture, Ministry of Water Resources, State Government, NGOs and Social Organizations should come forward to help the rural population otherwise the ray of hope for a better living through the implementation of the suggestions mentioned in the report will turn into a mirage. International bodies like UN may also come forward to help the real downtrodden resource poor rural population for alleviation of poverty and to improve the livelihood for a better socio-economic condition.

Genesis of problem

Bariarpur Tal lands have tremendous potential for the improvement of agricultural production because of the good fertility status of the soil but due to the lack of proper management of available resources, yield potential has not been achieved so far. The main problem of Tal lands is delayed drainage due to which farmers are not able to perform farming activities in time, resulting in poor agricultural productivity in 40,000 hectares of land lying between Ghoraghat and Bariarpur and Prasando to Khand Bihari in Munger district of Bihar. These lands remain inundated with water from July till January. The canal network is also not efficient and other parts face drought.

The bank full capacity of these rivers as well as that of its tributaries are inadequate due to which they are unable to contain the flood discharges and consequently spilling takes place over their banks causing floods in the basin. The Ganges river is also instrumental for water stagnation in low lying area due to back water flow/ over flow from the river. Due to low bank and inadequate channel capacity, all the channels in the lower reaches spill heavily over their banks even during normal floods. The flood-prone environments receive 50-400 cm water for more than a month during monsoon season, depending on the amount and duration of rainfall, and the depth, time and frequency of flooding (Singh and Khan, 2002). When the water level in the river Ganga rises and the backwater flow enters the local river system, it results in an inundation of a large area adversely affecting Tal area. Due to distinct topographical features and existing drainage system, drainage from different Tal areas occurs at different times. While conducting the survey at different locations of this Tal area, it was realised that due to clogging of existing drainage way and defunct sluice gate, water recedes by the first week of January in the Tal and the farmers of the area usually sow their winter crops around 15th January. Winter crops mostly suffer from the infestation of various insects and diseases. Usually, insects such as kajra pillu and pod borer heavily damage the gram crops at the time of germination and flowering, and at the time of pod formation, respectively. However, it was observed that the attack of insects can be minimised if the crop is sown at the proper time.

Reasons of water logging

Clogging of existing drainage ways (locally called as pian) due to the deposition of silt transported with river water spillage, collapse of side slopes of drainage way, etc. Choking of the natural drainage ways (nallas) due to inadequate capacity or non-existence of culverts below roads. Most of the existing sluice gates are non-functional and broken. At many locations, sluice gates do not exist where these are badly required. Due to delayed drainage, the sowing of winter (*rabi*) crops is delayed, on account of which less time is available for growth and maturity of the crops, resulting in poor production and inferior quality of the produce.

Investigation of the problem

A scientists' team visited the Noorpur area in Kalyanpur, which is about 23 km away from Inspection Bungalow at Haveli Kharagpur. The team saw the waterlogged area in Ghorghat and also visited with a motorboat in Mani river and went to many places like Kharia, Bahiar, Peepara, Kauria, and Chaukia river Ghats to see the waterlogged area and other related problems. The team traveled by foot upto Khandbihari village via Lakshmipur village, which is about 5 km away from Zokia Ghat of Kauria and observed many existing old ponds, nalas, and irrigation facilities. Later, the team visited the Zavayad area under the canal command, which is about 20 km away from Inspection Bungalow at Haveli Kharagpur. After that the team visited the Jalkunda area, which is about 5 km away from Pharpur village. Local people informed that there is a continuous waterfall from the hills of Jalkunda area, which further transforms in the form of a river. Unfortunately, after about 600 ft, this river converges in the form of a nalla with a very low discharge. It is very difficult to say where this water is lost inside the ground. Further, team also visited Jalkunda Jalashai (an earthen dam), where water could not be stored due to its diversion in other direction below the ground. Shampur Kali sthan dam with very low availability of water in the reservoir was observed. Team visited the waterlogged area of Bhadaura. Beside this, team visited Kharra river at Bageshwari and saw number of small tributaries joining this river. Daulati canal, which is upto Manjhgaon is not being properly cleaned and maintained. Team observed number of ditches and nallas, which were loosing their carrying capacity due to excessive weeds and silt deposition. Finally, team visited the Badua (Asarganj distributory), Amayia area and Mahande river.

Under Khand vihari irrigation scheme, about 35 years ago, a weir was constructed on Mani river in village Khand vihari. From this weir in addition to Khand vihari village about 17 village namely (i) Nishihara (ii) Bijalpur, (iii) Lakshmipur, (iv) Vishanpur, (v) Bahauna, (vi) Kendua, (vii) Kisanpur, (viii) Lohara, (ix) Sonmani chak, (x) Gaura, (xi) Agrahan, (xii) Badaki Manjh Gaon, (xiii) Chutaki Manjh Gao, (xiv) Vageshwari, (xv) Bhusi chak, (xvi) Chapri, (xvii) ladhui are irrigated. The excess water of Mani river flowing down towards north causes waterlogging in many villages in Bariarpur region. Waterlogging was also observed in west and north direction of village Khand Bihari. Due to water stagnation most of the fertile land was full of weeds and became uncultivable.

Steps needed to solve the waterlogging problem

To minimize the problem of waterlogging in this area following points may be considered:

(i) Both canals from Khand vihari weir need to be cleaned and maintained properly.

(ii) The bottom of the canals at many locations was observed below the level of fields and canals were looking like drainage ditches. Farmers usually irrigate their fields by creating obstructions to flow and building sufficient head in the canal. This causes uneven distribution of water among water users. Farmers at the head reach apply maximum water whereas, tail enders either do not get

upstream side. This problem can be tackled by either maintaining the proper bottom level and water level in the canals and involving water users in planning and decision-making. Check gates may be provided at enough spacing (on the basis of command area at the corresponding outlets) to raise the upstream water level in the canals. However, involvement of users in deciding the timings of operation of such gates is very important to ensure uniform distribution in whole of the command area without any conflict.

(iii) A structure may be required at the junction of western canal from Khand vihari weir and Kharra river

(iv) Construction of ring bund on both sides of Khand vihari weir upto Shasan Mauza.

(v) Excess water from Khand vihari weir needs to be stored at appropriate place and to flow down below causing waterlogging.

(vi) A diversion weir on Budava dam which is near eastern canal of Khand vihari weir.

(vii) Cleaning, repair and maintenance of Koyala and Dhober near eastern canal, Bela nala from eastern canal to Sonmai chak; Daulati nala from Mani river in Nishihara village, garhmaria nala in Lakshmipur village and other nalas.

(viii) Below Khand vihari weir at the confluence of Mani river and Kharra river Milak dam needs renovation.

(ix) Amaia and Zokia river bring lot of sand and water in the northern region of Kharagpur, due to which standing crop in the fields of Kisanpur, Lakshmipur, Baduna, Lohara, Majhgaon and Agrahan villages is wasted. There is a need of streamlining this water in the river by providing proper embankments.

(x) Near Bariarpur railway crossing under Ratanpur panchayat, the drainage channel (natural nalla) on the bank of urbi and Soti river is choked due to silting and is causing water logging because Ganga water enters in these rivers. One km. length of nalla of above area requires de-silting, digging and cleaning. Watershed Development Programme, Ministry of Rural Development, Govt. of India had approved a master plan of watershed development for Ratanpur panchayat during 1996. If it is implemented then water-logging problem in Soti/urbi river catchment may be solved. It may take care of Neerpur and Brahmpur railway crossing.

(xi) Area near Kalyanpur railway Station is waterlogged and approximately 8000 acres around Karhariya village used to be submerged. Jalkund seepage water also causes water logging till January. Boring may be tested up to 300-350 ft. depth. Jalkund seepage is to be checked. It is discussed separately.

(xii) Cleaning of Karhariya nala may ensure irrigation water in 16 panchayat.

(xiii) From Pipra to Maraiya Baihar (near khariya village survey is required to determine the slope (2.5 m width x 1 m. deep) for drainage channel.

(xiv) Feasibility of submerged weir for Gauraghat may be studied to increase the irrigated area.

(xv) Feasibility of construction of diversion weir at Chadkand, Kauriya (Shivala) and Choti Jokia may be studied.

(xvi) Cleaning and widening (approx. 5 Km.) of Balha garbheria link of Mani river is needed for drainage and keeping the entire area free from water logging. Cleaning from Khand vihari to Machgai may also be done.

(xvii) Feasibility of submerged weir for Jokhia river near Lohra village, Budhwa dam's and Jholi may be studied.

(xviii) Water harvesting structures may be needed in hill 310 Bhalohar and hill no. 314 baghmark. Both are joined and Rishikund nala is attached. Flume is damaged & needs repair for irrigation in 300 acres command.
(xix) Village Bhadora where Kharra river causes water-logging and 1.5 Km. Nal (durbari banth) may be desilted for escape of food water and submerged weir is also needed on Kharra river for irrigation.
(xx) Machali dam near Bahira village needs cleaning and repair for irrigation and check dam of Kali Asthan (Kali Ghati requires desilting and repair.)
(xxi) Nagra dam (Village – Chandpur) is broken and 800 ft. length dam needs urgent repair.
(xxii) Ghighai dam (Bageshwari vill.), Daulti darhi and Tava darh needs cleaning. Ring dam is needed from Harnam Gawai to Daulti darh.
(xxiii) Bhadora garh (Kharra river) needs sluice gate.
(xxiv) Feasibility of diversion weir at Baurbanna (Agrahanna of Kharra river), Kanha Dam, Babur Dam and Chaur may be studied.
(xxv) Feasibility of cleaning of Kharra river from Prasando to Bhusi Chak may be studied for increasing the drainage and early escape of water.
(xxvi) Twenty acres storage reservoir (Domarda hauz) made by Dharbanga Maharaj needs special care and repair.
(xxvii) Manga dam (Dulhar village) needs cleaning of Mangrpa (Belharni river), repair of dam and diversion weir.
(xxviii) Weir needs repair near Garhi Ghat bridge (Village Amayia-Chaur Gaon) and feasibility of putting diversion weir near Tulakhand and Binoulli Pokhar (near Mahadar), Dholpahari (near Belharni river) and Bajalpur village (south side) may be taken up.
(xxix) Check dam at Gai Ghat on Mahande river near Sangrampur, Gorogaon, Belsira may be taken up.
(xxx) In Goraho village near Gosai diversion weir and canal cleaning is needed.
(xxxi) Dhobia tank near village Narain, Tarapur block needs desilting and construction of outlets.

The farmers from villages of Ratanpur, Bariarpur, Padhia, Mahdeva, Neerpur, and Naya Chhavani reported that they were not able to cultivate their lands due to water stagnation for a long time in the region and non-availability of timely irrigation and drainage facilities. The ***main reasons of water stagnation*** are:

- Typical boat shaped land,
- Lack of drainage facilities for timely disposal of excess rain or flood water from land,
- Choking of existing nalas or drainage ditches due to silt deposition,
- Fishermen also create obstruction in flow by putting plastic sheets for head build up and help in creating the problem of waterlogging.

Possible remedial measures may be:

- Cleaning, repair and maintenance of nala/ ditches from Soti river
- Appropriateness of diversion weir towards south of Bariarpur raiway station needs to be examined. If it is causing waterlogging problem then construction of diversion weir in front of Bariarpur hospital may be investigated.

- Ummi river which carries water throughout the year, if connected with nalas can provide irrigation to most of the lands in Padia, Mahdeva, Neerpur and Lohachi villages.
- If a diversion weir is provided in a nala towards south of Ummi river lot of area can be brought under irrigation and water stagnation may be minimized.
- Jalkund Jalashai needs to be investigated thoroughly; if water is stored properly it can provide adequate irrigation facility to the farmers in that area during lean period.

Kalyanpur Tal area

Construction of drainage ditch or nala and carrying water in the already existing depression by the side of railway line can minimize the problem of water stagnation in Kalyanpur Tal area. Thorough investigation is required to create irrigation and drainage facilities in the area. If economically viable, possibility of introducing lift irrigation facility and installation of heavy discharge pump for drainage may be studied.

Jalkund (water fall)

Jalkund has an enormous capacity to provide irrigation to larger area but near Jalkund water disappears and insufficient quantity of water reaches to Jalkund Jalashay (water fall reservoir - which was built in 1967-68 with a total cost of 1.95 million rupees). On the other hand Jalkund water is seeping underground and at some point, water of jalkund is causing flood and waterlogging. A team of Geological Survey of India has visited the site during 1972-73 and submitted its report in Nov. 1975. (The Geotechnical report on seepage problem through Jalkund dam, Munger, 1973). Safety review of Jalkund dam, Dam Safety Cell, Water Resources Deptt., Govt. of Bihar also did some survey in Feb. 1999. However, no follow-up action was taken and the great source of irrigation has become a curse to the area, which is causing waterlogging and keeping whole area submerged for almost 8 months of a year. A portion of the *Geotechnical report* is quoted here, "*The reservoir is not building up due to presence of fissures rock of the basin. As a result the required benefits are not being achieved. The remedial measures should be taken up in consultation with GSI.*" However, no follow-up action is taken till date. A GSI team is immediately needed for detailed study and follow-up action to save larger area from the curse of waterlogging. This water may be used for irrigation,

Suggestion for improving the canal irrigation system

Presently, Irrigation department feels that its responsibility is only about release of water from canals. The irrigation department is not bothered whether water reaches to the fields or not. This is a matter of concern. The team is of the opinion that Irrigation department should not only timely release the required amount of water in the canals but it should also assure canal operation as per requirement and pre-decided schedule, uniform distribution of water among farmers, repair and maintenance of canals, outlets and broken structures, cleaning of weeds and sand or silt deposition,

removing obstructions from the canals in participatory mode. A separate wing of Drainage Engineers in the Irrigation department should also look after safe and early disposal of excess water in the Tal area, which creates waterlogging in the canal command. Minor irrigation department should be given the responsibility of looking after irrigation and drainage requirements in the canal commands. Soil conservation department should be made responsible for controlling soil erosion using soil conservation structures. Thus, the problem of waterlogging is basically due to mismanagement of water, which can be solved if Irrigation department with a well trained wing of drainage engineers, minor irrigation department, soil conservation department, and department of agriculture join hands and take the responsibility to work in participatory mode after taking into account the interest of water users.

Agronomic problems

Major agronomic problems related to crop production as observed by the team are given below:

- Productivity is declining (average yield of rice and wheat is 15 q/ha each only) due to improper irrigation system particularly by canal which needs better upkeep and maintenance.
- Farmers were unable to go for better choice of crops, improved agricultural practices and technology due to lack of knowledge.
- During rainy season due to improper irrigation, rice crop gets affected in the early vegetative stage. It is either due to drought injury or excess standing water in the field.
- Transplantation gets delayed due to inadequate water, shortage of power and labour. Crop also suffers due to weed infestation during early growth period.
- Late transplanted crops are damaged by flash floods, which usually occur in the flood plains during mid August to mid September.
- Larger area is being covered by only one rice variety i.e. Swarna. Very few farmers grow Saryug 52, Sita and MTU 1001. Varieties used by local farmers hardly have resistance/tolerance to the pest attack during crop season.

Agronomic recommendations to improve the agricultural production

- Rice varieties like Vandana, Turanta, Prabhat, Saket-4, Pusa 2-21, IR36 for 0-5 cm upland field may be taken.
- Rice varieties like Jaya, Sita, Dipa, Archana, Rajendra Dhan 201, Rajendra Dhan 202, Sujata and Kanak for medium land rice (15 to 30 cm water) eco-system is suggested.
- Rice varieties like Radha, Rajshree, Pankaj and Vaidehi under low land rice (30 to 50 cm) eco-system is suggested .
- Rice varieties like Janki and Sudha for 50-100 cm water depth; Varidhi upto 200 cm water depth is suggested.
- BR-9, N.P. 49, Sugandha, Kamini as long slender basmati may be taken.
- Farmers transplant on an average only 10 hills/m^2 and there are only 170 tillers/m^2. This leads to very poor stand. It is advisable to transplant 33 hills/m^2 and not less than 250 tillers/m^2 for achieving good yield.

- Under shallow depth water situation, direct sown rice in June is preferred over transplanting in July.
- Farmers use 3 times more seed rate in nursery and delay planting by one month. If they transplant timely with 1/3rd seed rate, 30 to 40% increase in yield may be achieved easily.
- Under rainfed lowland rice, variety Rajshree linseed with normal seed rate and fertilizer as relay crop is advisable.
- Rice-Rajmash cropping system in this situation is advocated because it will give better returns.
- Under shallow depth water situations, direct sown rice followed by seasame (variety Krishna) is more profitable.
- Rice-Sweet potato (Variety cross-4) also seems to be profitable.
- In deep to typical deep-water situation, rice + sesame or rice + moong should be advocated.
- Application of 40 kg N in 2 splits and 40 kg P_2O_5 /ha as basal dose would be the most economic dose especially for sequential crops.
- Rice +Fish farming should be encouraged. This not only increases the total return but also reduces incidence of stem borer infestation in comparison to rice crop alone.
- Rice + Fish and silviculture system also provide more return.
- Good water management practice (wetting and drying) can reduce the population of Brown plant hopper in wet (*kharif*) rice.
- Split application of potash fertilizer improves the plant ability to resist the buildup of rice hoppers and stem borer.
- *Ipomoea aculeata* weeds were very troublesome for cultivating winter (*rabi*) crop especially wheat after rice. It is advisable to recycle the tender weed before flowering during wet (*kharif)* season into the soil by burying and proper puddling operation. This will also increase the nitrogen status of soil (Khan *et al.*, 2001).
- Selection of appropriate cultivars of lentil and gram as per the recommendations of State Agricultural University and other institutions related to agriculture.
- Purchase of seeds and other agricultural inputs from a reliable licensed shop is recommended to check adulteration.
- Lentil and gram seed treatment with fungicide like Thiram/Captan @ 2.5 gm/ kg of seed followed by Chlorpyrifos 20EC @ 8 ml/kg seed, protects the crop from pest infestation.
- *Rhizobium* culture after 24 hours of seed treatment helps in making atmospheric nitrogen available to plants, resulting in 15 to 20 % increases in yield.
- Sowing of recommended seed rate of lentil or gram between mid October to mid November gives good yield and sowing thereafter results in deterioration of quality and quantity.
- For weed control, a spray of Pendimethaline 30 EC @ 5 lit per hectare is effective and economical.
- Introduction of additional crop in summer months like Moong, which is of shorter duration, needs minimum water and gives good returns. In irrigated areas, onion is remunerative and less susceptible to grazing. Sunflower, sesamum, maize, and short duration paddy may also be tried during summer months. Improved cultivation of Bengal gram can also be initiated.

- Soil is medium in fertility i.e. medium in N and K_2O and low in P_2O_5. Medium to high response of Zinc in all cereals is reported but Munger soils are rich in Sulpher therefore, Zn should be applied in the form of zinc-oxide.
- The possibility of increasing cropping intensity from 130 % to 200 % is possible by utilizing ground water potential through irrigation projects.
- Waterlogged areas viz. Ghorghat, Nurpur, Khariya, Bariyar, Pipra and Bhadaura can give good yield of pulses during winter (*rabi*) season if proper management strategies are adopted.
- In order to protect gram crop from attack of pod borer corriander may be mixed with gram in 1:100 ratio before sowing.
- On farm development works should be initiated to drain excess water at an early date and sowing of winter (*rabi*) crop in time.
- Farmers should be encouraged to develop irrigation facility because if irrigation facility is available a good crop of onion can be grown in such areas after harvest of pulse/wheat crop.
- Farmers training and extension program can play an important role in improvement of agricultural production. Krishi Vigyan Kendra (KVKs), Agriculture departments and voluntary organizations should be geared up to train farmers regarding seed treatment process before sowing, method and time of application of water, fertilizers, nutrients and plant protection measures. Farm machinery's and post harvest technologies through front line demonstrations, farmers fair, training camps and other communication means should also be used.
- Farmers should also be informed about the financial institutions providing credit to the farmers for various developmental works related to agriculture. Extension agencies should help farmers to strengthen farmers association and committees. Youngsters should be trained about crop and animal husbandry so that they can be self-reliant and help the farmers of their villages in making available the quality inputs from reliable licensed shops in time.
- Farmers need to be educated about the loss in yield due to delayed drainage. They should be motivated to clean and maintain the existing drainage ditches in a participatory mode.

The aforesaid study, observations, recommendations made by the team of Scientists needs follow-up action. Ministry of Agriculture may request to Water Resources Department for feasibility evaluation including the cost of the project and get the work done under their supervision. Krishi Vigyan Kendra (KVKs), State Agriculture Department and Voluntary organizations may implement recommendations related to improved agronomic practices.

Acknowledgments

This work was done within the framework of the Associateship Scheme of the Abdus Salam International Centre for Theoretical Physics, Trieste, Italy.

References

Khan, A. R., Chandra, D., Nanda, P., Singh, S.S., Ghorai, A. K. and Singh, S. R. (2001). Sustainable rice production through nutrient management in coastal region of India. *National seminar on water and land management including CAD for socio-economic upliftment of north eastern region.* NERIWALM, Guwahati. November 22-23, 2001. pp. 70-73.

Singh, S. S. and Khan, A. R. (2002). Strategy for managing natural resources in flood – prone eco-systems for sustainable agricultural production. *Acta Agronomica Hungarica*, 50(1) : 107-115.