

## **Title: Overcoming water logging in flood-prone areas towards securing agricultural livelihoods**

Ramamohan Venkata Ramachandru, Joint Director (Sustainable Livelihoods), Centre for World Solidarity(CWS), Hyderabad, India.

### **Abstract**

North Bihar in India is a flood-prone area with recurring floods in Kosi, Gandak, Bagmathi and Mahananda river systems affecting millions of people every year. Floods not only displace people, damage their habitations but also affect their livelihoods. Water logging in agricultural lands is a serious problem in north Bihar, seriously affecting the agricultural activity and livelihoods. Increase in bed levels of rivers and blockage of free flow of surface drainage into river by artificial embankments, is resulting in prolonged water logging every year. Improving the drainage from these water logged areas by digging drainage channels and renovating drainage networks has been demonstrated successfully in few pilot areas. Sustainable agricultural practices, such as introduction of improved varieties of seeds, promotion of crop intensification methods in Paddy, Wheat and Mustard and promotion of household level vermi-compost units resulted in enhanced production and income levels of small and marginal farmers. This paper highlights the processes and impact of these interventions by CWS and its local partner organizations over last five years period. Need for replication of such works by the State and National Government through a systematic river basin approach has been highlighted.

Key words: agriculture in water logged areas, drainage channels, flood management

### **1. Introduction**

Bihar is one of the most poverty-stricken States in India. High incidence of poverty relates to high population density, low per capita availability of agriculture land, low agriculture productivity and illiteracy. Bihar is also the most flood-prone State in India. About 70% of its geographical area is affected by flood. The plains of North Bihar has been witnessing flood for last several years. Most of these floods occur due to breach of artificial embankments constructed as a part of river training and flood control measures by the State Government. In August 2008, there was a major flood in North Bihar due to breach of embankment on River Kosi resulting in huge loss of life, crops and livestock.

Water logging is another problem in North Bihar that has reached grave proportion. Construction of embankments to rivers like Kosi, Gandak, Bagmathi and Mahananda and their tributaries without proper drainage network to relieve farm lands on both banks is resulting in water logging in agricultural and homestead lands every year. Recurring floods combined with water-logging (due to improper drainage system), has been affecting livelihoods of people, particularly the marginalized communities. This has resulted in increasing trend of migration for shelter and work to other states.

Since 1960s, Centre for World Solidarity (CWS) has been actively involved in development works in India. It works in partnership with large number of Non Government Organizations (NGOs) and networks. Its goal is to promote people-oriented management of natural resources, through participatory processes to strengthen the livelihood systems of marginalized communities. CWS has been working in flood and water-logged areas of Bihar for last 20 years. Initially, it was involved in providing relief to flood victims. It has been supporting campaign and advocacy efforts in different river basins of North Bihar.

CWS support for campaign and advocacy has centred on proper construction and maintenance of drainage networks in flood-prone areas to relieve farm lands from water-logging and consequent dislocation of communities. Grass-roots work of CWS focus on developing 'drainage systems' and to strengthen rural livelihoods through promotion of sustainable agriculture and alternative off-farm livelihood. In this context, CWS with assistance of Sir Dorabjee Tata Trust (SDTT), Mumbai, India has been implementing the project, 'Promotion and Strengthening Livelihoods of the Marginalized Communities with specific focus on Flood and Water logged Areas in Bihar'. The overall goal of the project was to increase livelihood opportunities for the flood affected population and cut down the migration rate in flood-hit areas.

This project is being implemented by CWS and its 5 grass-roots partner organizations (Welfare India, Gramsheel, Gram Bharti, Abhigyan Disha and Nav Jagriti) in 23 villages spread across 4 districts in North Bihar. The project covered specific villages in Manihari and Mansahi blocks of Katihar district, Supaul and

Raghopur block of Supaul district, Benipatti block of Madhubani district and Simariya block of Muzafferpur district.

## **2. Interventions and Impact (CWS, 2011)**

Historically, North Bihar's flood plains used to get flooded during monsoon period (from July to October) every year. In that process, the agricultural lands used to get the benefit of fertile sedimentary deposits enriching the soil quality and nutrient status. After receding of floods, farmers used to cultivate the lands with staple food crops such as wheat, barley etc. With increased population pressure and growing habitations around river flood plains, meandering rivers started creating havoc. Flood control has received major focus in post-independent India.

From first five year plan onwards, State and National Governments embarked on river training works such as construction of earthen embankments and other flood control structures on major rivers in Bihar. Though construction of embankments helped in containing the rivers in spate, new problems started emerging over a period of time. These structures obstructed free flow of drainage water from surrounding lands into the river, resulting in water-logged on both banks of the river all along the embankments. Water-logging, which used to be for few months during monsoon has now extended beyond monsoon period and many of the such agricultural lands were rendered unsuitable for agriculture due to water stagnation all round the year. As the existing network of drainage channels got silted up and deteriorated, the problem expanded to many more areas.

Livelihoods of marginalized communities like small/marginal farmers, share-croppers and wage-earners depend on agriculture and allied activities. However, they are unable to take up agriculture, as their agriculture land is affected by flood and water-logging almost every year. Hence, reclamation of agriculture land through drainage assumes importance. Drainage requires scientific planning and use of appropriate technology. Technology interventions like use of quality seeds, vermi-compost, and crop intensification practices have been quite promising in enhancing productivity and production of agriculture crops. CWS, through its NGO partners, not only reclaimed such water-logged agricultural lands but also enhanced the productivity by introducing sustainable agricultural practices.

### **2.1. Reclamation of agriculture land through improving the drainage**

As a part of this initiative, CWS and its partners identified water-logged agricultural lands in their operational blocks. Farmers owning these lands were mobilized to come together as a group and motivated them to be part of the reclamation work. Since, water-logged areas often extended beyond the boundary of a village or gram panchayats, all the farmers from different villages were brought together towards collective action. Technical surveys for the feasibility of interventions were carried out involving experienced engineers. Topographical mapping was done to ascertain the natural slopes and drainage lines. Alignment of existing drainage channels was mapped and their present status studied. Farmers committees involving few farmers' leaders are formed, which participate in all these processes and takes key decisions regarding the nature and extent of renovation work to be carried out.

Most critical part of this process involves realigning the drainage lines in order to remove the flood waters from the agricultural lands in shortest possible time. This often involves digging new connecting channels that pass through private agricultural lands, of the beneficiary farmers and also of farmers in neighbouring villages. Bringing them together and convincing them on digging such channels at the identified locations is the difficult part of the process. Since, digging such channels through their own farm lands results in loss of farm land for them and also may affect the future agricultural operations; some farmers not only hesitate but also obstruct such works. CWS and local partner NGOs facilitated several meetings in the villages and helped all those farmers to come on terms that are agreeable to all. Often, village elders, gram panchayat elected representatives and important political leaders in the locality are also involved for arriving at consensus on such works.

CWS could reclaim about 6400 acres of land belonging to around 4900 farming families in past 7 years. Before this intervention, these lands were unsuitable for agriculture and hence left by the farmers. But, after the drainage improvement works, all these farmers started cultivating at least one crop during *Rabi* (Oct-Jan) season every year (see Fig.1). It must be reminded that the reclaimed area still suffers from submergence during the monsoon season and unless there is a severe drought in the State, crop cultivation during *Kharif* (June-Sept) season is not possible in these lands. Following Table 1 presents the extent and location of lands reclaimed so far through various interventions of CWS and its partners:

Table 1: Total land area reclaimed and people benefited

Sl.	District	No. of villages	Number of beneficiaries	Area reclaimed (acres)	Year of reclamation
1.	Muzaffarpur	6	855	1000	2007-2008
2.	Supaul	5	1382	2120	2007-2010
3.	Sitamarhi	4	1141	820	2009-2010
4.	Saharsa	6	1560	2470	2003-2005
	<b>Total</b>	<b>21</b>	<b>4938</b>	<b>6410</b>	

Fig.1: Land reclamation areas in North Bihar

	
Lands reclaimed from water-logging adjacent to the embankment on river Gandak in Muzeffarpur district	Channel dug connecting the water-logged lands with the river in Muzeffarpur district
	
A field drain renovated in Dharnipatti, Supaul district	Land reclaimed being prepared for cultivation during October 2010

The beneficiaries of drainage improvement work never believed, in the first place, that their land can be drained out and made suitable for cultivation. On seeing the success of this intervention, neighbouring villagers started inviting CWS and its partners to take up lands in their villages also.

Improving drainage networks at local level has emerged as a successful intervention. Wider community level campaign and participation provided a foundation to take up such interventions. At local level, community

mobilization involving all the households of village supported planning and implementation of this intervention. This led not only to people contributing in form of labour but also community motivating specific persons to donate part of their land for digging field drainage channels. Active involvement of Gram Panchayat leaders helped to resolve disputes emerging within and between villages and take forward the initiative as per the plans. In water logged areas, it is difficult to measure land gradient and to identify contour lines. Developing drainage systems requires both theoretical understanding and extensive practical experience. Such expertise is generally not available at local level. Providing appropriate technical skills to local people, Gram Panchayats and local NGOs at right time also contributed to success of this intervention.

**2.1.1. Case study of Dharnipati and Bauraha villages in Supaul district**

About 200 acres of agriculture land belonging to farmers of Dharnipati and other neighbouring villages like Bina, Bhabangama and Laxmipur in Supaul block of Supaul district was suffering from water-logging every year for last several years. It was a dream for farmers of Dharnipati village that one day they would be able to grow crops in their agriculture land. Gram Sheel, with support from CWS, repaired the sluice gate which is dysfunctional on the nearby drain and field drains were renovated and connected to the main drain. Farmers nominated a committee to play supervisory role in all these activities and in most of the physical works, villagers contributed around 20% of the cost in the form of labour. The renovation works were done at a total cost of 600,000 INR (approximately 10,000 Euro) over the period 2007-09 (see Fig.2 & 3 for location and interventions).

Fig.2: Location of Land Reclamation sites in Supaul district

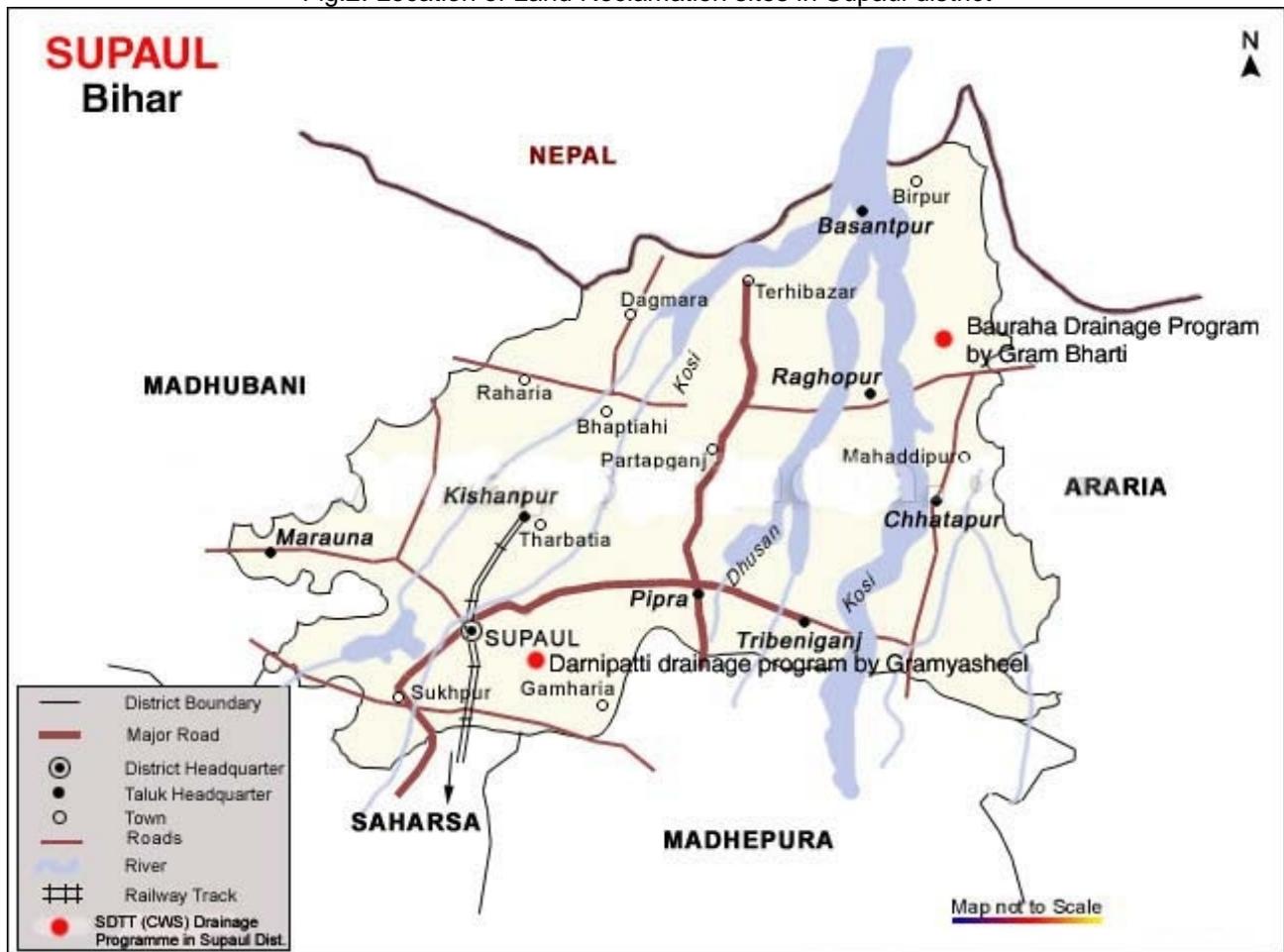


Fig.3: Drainage renovation work in Supaul district



There has been substantial change in the area with about 95% (190 acres out of total 200 acres) of the agriculture land has been fully reclaimed and remaining land partially. Since 2008, farmers started growing paddy (Swarna and Pankaj varieties) in *Kharif*, wheat, mustard and red gram in *Rabi* season and again paddy in summer season. Farmers have been contributing rice and wheat to village fund (currently Rs.5000/- is available), for the village committee to be able to take up repair and maintenance of these works as and when required. Village committee has also assumed the responsibility of operation and maintenance of sluice gate.

Similar interventions have been taken up by Gram Bharti near Bauraha village in Raghapur block of Supaul district (see Fig.2 for location). About 600 acres of land was reclaimed benefiting 242 farmers from Uttam Nagar, Borah and Mahavir Nagar. In reclaimed agriculture land, farmers have been able to grow paddy, wheat and maize. Prior to reclamation of agriculture land, wherever the farmers were able to grow paddy, the average yield of paddy was as low as 3 quintals per acre. Very low yield of paddy was mainly due to water-logged conditions. After reclamation of their agricultural land the yield of paddy has gone up from 3 quintals to 8 quintal per acre, which is a remarkable achievement for farmers as well as CWS.

## 2.2. Facilitating Use of Quality Seeds

Agriculture scientists have developed appropriate quality seeds suitable for flood and water logged areas. This includes paddy seeds like Swarna Sub 1 (resistant to water-logging for as long as 25 days) and Rajasri (135 to 140 days crop period having longer tillers). But, the popularity of these seed varieties is limited among farmers, due to lack of knowledge about them and also because of limited seed distribution and multiplication efforts by the Agricultural research stations and Department. Due to frequent occurrence of floods, farmer loose crops and hence have limited access to seeds. Access to quality seeds, especially where agriculture land has been reclaimed, has potential to enhance agriculture productivity and production.

After reclamation of water-logged lands in Kakuria of Simariya block in Muzafferpur district, Nav Jagriti had taken efforts to facilitate availability of appropriate quality seeds. Farmers clubs were formed in each village and in each of the farmers' club, progressive small and marginal farmers were identified as seed producers. Foundation seed from State Agricultural University, Patna was supplied to these seed growers. Farmers were trained to take up scientific practices related to seed production. The seed growers were encouraged to exchange seeds amongst themselves and also sell to other farmers.

Instead of production of normal crop, farmers have taken up production of seeds of paddy (Swarna Sub 1 and Rajasri varieties) and wheat (PBW 343 and PBW 373). Nav Jagriti has ensured availability of foundation seeds for multiplication and encouraged informal exchange or sale of seeds amongst the farmers, than

facilitating certification process. Most of the farmers were from the same locality and were aware of the efforts related to production of seeds.

Facilitating multiplication of quality seeds led to increase in availability of quality seeds locally to many farmers. Both seed growers and seed users experienced increase in yield in the range of 15 to 50%. As seed growers sold seeds instead of produce, they could get about 30% higher price. This resulted in substantial increase in income of the farmers. While farmers could get quick access to new varieties relevant in context of flood and water-logging, scientists in Agriculture University could get opportunity to take up trial and demonstration of new varieties. This was a win-win situation for the farmers, facilitating partner organization and scientists. Experience of this intervention suggests that it is relevant to introduce quality seeds and encourage informal exchange at farmers' level, than going through certification process. Farmers' club as an institution has been quite effective for seed production efforts.

### **2.3. Agriculture Extension through planned Exposure Visits**

Exposure visit is considered to be a proven agriculture extension tool. If it is adequately planned will result in best results and long-lasting impact on the participants. Gramsheel, with support of CWS, organized exposure visits to selected progressive farmers on sustainable crop intensification methods such as System of Rice Intensification (SRI), System of Wheat Intensification (SWI), Intensification of Mustard, bee-keeping and use of vermi-compost for soil health management. Intensification in Paddy, Wheat and Mustard primarily involves early transplantation of seedlings; wider spacing between plants and alternative drying and wetting of field instead of inundated conditions in the field.

About 20 progressive small and marginal farmers from Dharnipatti and surrounding villages were carefully selected and taken on exposure visit in and around Supaul district where individual farmers have been practising SRI, SWI, and Mustard Intensification methods with the support from PRADHAN, a reputed national NGO working in Bihar. It was thought that progressive farmers would be able to interact with Scientists and quickly comprehend different aspects of the new methods and technologies. They would also take necessary risk and be early adopters of new technologies. With success of the technology in local context, other farmers are likely to adopt the technologies.

After the exposure visit, Gramsheel encouraged the farmers to practice different technologies that they observed elsewhere. On returning from exposure visit, some of the progressive farmers started practising SWI, mustard intensification and production of vermi-compost in small pits at household level (Fig.4). By adopting SWI, the yield of wheat doubled and farmers are expecting similar yield increase from mustard through intensification practices. With application of vermi-compost, yield of potato crop also doubled giving substantial raise of income to these farmers.

There has been informal sharing of the success amongst other farmers which motivated other farmers also to adopt technologies like SWI and intensification of mustard. With the success paddy cultivation in summer in reclaimed land at Dharnipatti, officials of Agriculture Department and Scientists of Rajendra Agriculture University, Pusa, Samastipur have started considering this as successful demonstration site. Farmers from other areas have started coming on exposure visit to this area. It was observed that exposure visit, if well-planned promotes new technologies. There would be adoption of technologies by farmers exposed to new technologies. In due course, other farmers also would adopt new technologies. Involvement of progressive farmers, detail planning and facilitating demonstration and adoption of technologies by progressive farmers was critical to the success of exposure visit.

Fig.4: Agricultural interventions in different locations

	
<p>A vermi-compost unit being maintained by a farmer in Benipatti block, Madhubani district</p>	<p>Summer paddy crop cultivation in reclaimed land in Dharnipatti, Supaul district in March 2010</p>
	
<p>Farmers cultivating mustard crop in reclaimed lands</p>	<p>A vermi-compost pit being maintained by a women in Benipatti block, Madhbani district</p>

Project has made conscious effort to involve progressive farmers with small land holdings in sustainable agriculture activities. Such farmers have been involved in seed multiplication and were taken on exposure visits. Farmers' club has emerged as an effective institution for seed multiplication and delivery of agriculture extension services. Most of the progressive farmers are members of farmer's club. With success of interventions by farmers' club members, the agriculture interventions, such as SWI, mustard intensification and vermi-composting could spread to other farmers in the project villages. Success of agriculture interventions can also be attributed to linkage with research institutions. CWS supported its partner Gram Sheel in establishing initial linkage with Rajendra Agriculture University, Pusa, Samastipur. At district level, partner organizations developed linkage with Krishi Vigyan Kendra (KVK) of respective districts. This led to quick access to new and improved varieties of seeds and new technologies. Linkage with research institutions and other leading NGO, PRADAN, supported in organizing planned exposure visit, training and demonstration.

### 3. Conclusion

Through this project, CWS brought to light the problems of farmers in water-logged areas and could successfully demonstrate drainage improvement at local level. At policy level, CWS has been advocating with officials at District and State level for Government to take up on a larger scale in North Bihar. Facilitating interventions like improving drainage networks requires prior experience in similar work and strong presence

at community level. Hence local partner organizations with similar institutional strength were involved in facilitating development of drainage system.

It started with identification of potential site and exploring technical feasibility. Community mobilization process involved interaction with key informants including Gram Panchayat leaders. Before renovation work, series of village meetings were organized to discuss and plan different components of the work. Through on site visits, detailed technical plan was developed. Credibility of local partner organization, initiative by Gram Panchayat president and leaders supported in getting necessary Government permissions to take up the physical renovation works. Similarly, involvement of whole village facilitated in acquiring private land, wherever necessary, for digging drainage channels. Ultimately this intervention has led to increase in cultivation area, yield of crops and income at family level. As agriculture has been revived, there is increase in availability of wage earning opportunity locally for landless families. This has further led to reduction in incidence of distress migration.

The field level officials of Water Resources Department have appreciated the relevance of renovating 'drainage systems' at local level, more so at a lower cost compared to the Governmental estimates with the participation of community. After seeing success of this intervention, some of the neighbouring Gram Panchayats have taken up similar works under National Rural Employment Guarantee Scheme (NREGS) of Government of India that provides wage employment to rural poor. Community mobilization played a key role in success of these initiatives. As Gram Panchayats was involved from planning stage, they took lead in getting necessary Government permissions from Water Resources Department for carrying out physical works. In future, Gram Panchayats are also likely to take up repair and maintenance of drainage networks renovated leading to their long-term sustainability.

In the context of drought-prone areas, Government of India has been supporting a comprehensive program called Integrated Watershed Management Program throughout India for soil, water conservation and livelihoods enhancement in watershed approach. In irrigation command areas, State and National Governments have been promoting Participatory Irrigation Management (PIM) and development of command areas by involving Water Users Associations (WUAs). However, there is no similar attention and national initiative for renovating and improving the drainage networks in water-logged areas. With increase in incidence of flood and water-logging, specifically in context of North Bihar, there is need to develop program strategy for promoting integrated livelihoods enhancement for marginalized communities.

Based on the pilot experiences from this project, CWS would like to further demonstrate development of drainage system in varying flood and water-logging contexts in Bihar. Such interventions would require appropriate technical skills at local level, which is generally not available. Hence, there would be efforts to develop a cadre of technical persons through orientation and hands-on training at village level. Attempts would be made to further replicate drainage renovation works by mobilizing funds from NREGS. At the same time, CWS will be engage with the State Government departments like Water Resource Department to take up drainage improvement works at river basin level on a priory basis.

#### **4. References**

CWS (2011), Promotion and Strengthening Livelihoods of the Marginalized Communities with specific focus on Flood and Water logged Areas in Bihar - Case Studies and Best Practices.