UNIT 16 PARTICIPATORY IRRIGATION MANAGEMENT AND WETLAND CONSERVATION

Structure

16.1 INTRODUCTION

Water is absolutely fundamental to life. There can be no life without water. The earth is the only known place in the universe, where liquid water exists in substantial quantities. Oceans, lakes, glaciers and other bodies of liquid or solid water cover more than 70% of our world's surface. Water performs a number of direct and indirect functions in the ecosystem, which you have studied in Block 1 of MED-006.In this unit we will describe only about irrigation and related issues

Sources of irrigation water include ground water, nearby watercourses, such as rivers and streams, natural lakes and rivers and artificial reservoirs. Large-scale irrigation also causes environmental problems, such as construction of reservoir changes the local environment. Some natural habitats may disappear; stream pattern changes and erosion rates increase in the watershed of the reservoir. Around 40% of the world's food crops are produced by irrigated agriculture. The performance of irrigation and drainage is critical to the food supply and to farmers' incomes, as well as to the environment.

In this unit we will study about the participatory irrigation management and various other factors such as irrigation and poverty, gender and participatory irrigation

management; and participation in the irrigation sector (benefits, cost and risks and conditions for success.

We have also discussed participatory irrigation management in India; wetland resources which constitute an important part of our resources, and integrated wetland management and conservation in India; and integrated wetland and river basin management.

Objectives

After studying this unit you would be able to:

- define participatory irrigation management – A new user-oriented approach to irrigation,
- describe participatory approach for irrigation management,
- list various factors such as benefits, costs and risks and conditions for success in participatory approach for irrigation management, and
- describe integrated management and conservation of wetland resources through participatory approach.

16.2 PROBLEMS IN IRRIGATION MANAGEMENT

The distribution of water often is described in terms of interacting compartments in which water resides for short or long times. Human concerns regarding water can be divided into two categories; quantitative and qualitative. Quantitative refers to such issues as, is there enough water to meet our needs? What are the impacts of diverting water from one point of the cycle to another? Qualitative refers to such issue as; is the water of sufficient purity so as not to harm human or environmental health?

Managing irrigation so as to achieve efficiency, equity and sustainability is very difficult. Market mechanisms are not enough. High prices for water when it is scarcest mean that low-income users may lose their access to water. Unrestricted use, if prices are low may lead to pollution, waterlogging and over-use of groundwater.

In India governments intervene, and even directly manage irrigation systems. However, when a centralized agency is in charge of planning and operating an irrigation system, the result is often too much bureaucracy. Too much money is spent on staff salaries. As a result, the cost of water becomes high, and yet the irrigation service remains poor. The result is a vicious circle of high costs, poor services and low payment of fees, leading to inadequate funding and further deterioration of services.

The ultimate goals in managing irrigation water are efficiency, equity and sustainability. Efficiency has been achieved if every drop of water has been properly allocated and used, without any waste. The goal of equity means that water is fairly distributed among users. Influential farmers may have better access to water than poor farmers. In some cases, ideals of efficiency and equity may be in conflict. The goal of sustainability means that the users of today should maintain the quality and quantity of water resources for the use of future generations

One way out of this difficult situation is the participatory approach to irrigation management. Users are involved at all levels, including construction and operations. It seeks to give greater efficiency at a lower cost.

16.3 THE PARTICIPATORY APPROACH

World Bank has carried out a program of Participatory Irrigation Management (PIM) since 1994. One of the first countries where it was applied was Mexico. By 1995, more than two-thirds of the nation's irrigation network had been transferred to 316

irrigation associations. Following Mexico's lead, other countries, including Turkey and some Indian states, have adopted similar systems. PIM is not a new idea. Irrigation associations have existed in many parts of Asia for decades, including Japan and Taiwan. Governments also get benefit from PIM by reducing subsidies for irrigation. Farmers also usually are winners, since they enjoy a sense of ownership and improved services. The irrigation department may be a loser, as its budget, staff and authority are all likely to decrease.

16.3.1 What is Participatory Irrigation Management?

Participatory Irrigation Management (PIM) covers a variety of different ways in which water users can be involved in the planning, construction, operation and maintenance of irrigation systems. Participation ranges from being informed and able to express views to situations where users and their representatives jointly or solely hold authority to govern irrigation systems and determine the irrigation services to be provided.

PIM or irrigation management transfer (IMT), in which farmer's groups take over the repair, management and maintenance of Government irrigation canals in exchange for water supply from state-controlled reservoirs (Parthasarthy, 2000).

16.3.2 Some good Examples of PIM

The majority of irrigation systems around the world which, were originally built and managed by local communities, constitute examples of good PIM. This includes centuries-old locally governed irrigation systems in most regions with irrigated agriculture, including Asia, Europe, Africa and North and South America. During the twentieth century, government agencies took an increasing role in directly building and operating large scale irrigation systems, often in ways that limited the capacity for user participation. More recently, initiatives in many countries have sought to reverse this process, making agencies more responsive and giving users a greater voice in management. The Indian state of Andhra Pradesh has transferred all management control to local bodies within large scale systems irrigating millions of hectares, and similar initiatives are now underway in many other places.

For PIM as with other kinds of reforms, there is sometimes a tendency to idealize "models," with exaggerated success stories. Increasing participation in irrigation management requires compromises and tradeoffs, building coalitions, effective management, dealing with political and financial constraints and continuing learning and adjustment. There is always scope for improvement in PIM.

16.3.3 Benefits from PIM

Participatory irrigation management can result in more responsive irrigation services, which may include more timely, adequate and reliable water delivery. Canal cleaning and other maintenance tasks are often done more effectively, due to more productive use of available budgets and increased provision of resources by irrigators. When other conditions are suitable, PIM can facilitate more efficient and profitable irrigated agriculture.

PIM is often advocated as a way for farmers to take over more responsibility for paying the costs of irrigation, and often does result in farmers providing more resources in cash and kind. The financial capacities of farmers are shaped by the profitability of irrigated agriculture, and by the institutional arrangements available for financing major repairs and improvements. If effective mechanisms are not in place to provide for maintenance and rehabilitation, then any apparent savings in government subsidies for operation and maintenance are lost due to deferred maintenance and infrastructure degradation. Overall economic benefits to farmers and society depend on increasing the efficiency and productivity of irrigation management.

The distribution of benefits from PIM depends on how the benefits of irrigation itself are distributed. In many countries, benefits of aggregate investment in irrigation are largely received by food consumers rather than farmers, in the form of lower prices resulting from food production surpluses. Increased yields and cropping intensity can provide more employment for cultivators and agricultural laborers. Reforms to promote PIM do offer an important opportunity to make management more democratically accountable to stakeholders, strengthening their rights to irrigation water and their participation in governance of a vital resource.

16.3.4 Difference between PIM and Irrigation Management Transfer

Irrigation management transfer (IMT) involves a particular kind of change, it is a form of PIM where user representatives have not just a voice in management but hold the power to choose what services they will receive. This often takes the form of a body of farmer representatives who determine key policies and plans for irrigation system management. IMT is thus a particular form of PIM, which typically requires a comprehensive set of institutional changes in order to be effective.

16.3.5 Management of Irrigation by Farmers

A common question is whether farmers actually have adequate technical knowledge and skills to manage irrigation. A first simple answer is that in many cases farmers can and do manage irrigation. In India, our farmers were managing irrigation system. This is even clearer if one looks at the large role farmers play, sometimes informally, even in large irrigation systems. Practice in the field often differs from official policies that may formally restrict farmer's roles below tertiary level outlets. PIM provides a way to draw on the knowledge and skills that water users have concerning all levels of management. However the most important part of PIM concerns involvement of farmers in key governance decisions, which can then be implemented by farmers or specialized technical staff. Where specialized skills are needed, agency-governed or farmer-governed organizations can hire engineers, gate operators and others with technical skills.

16.3.6 Problems with PIM

PIM like any significant change may face difficulties, requiring formulation of new policies and procedures, retraining of those involved in managing irrigation, rearranging irrigation finance and other structural changes in irrigation institutions.

The obstacles facing PIM and IMT are sometimes simplistically seen as just a matter of government withdrawing or reducing resources for irrigation. However long run success requires good communications and facilitation during a transition to new management arrangements, proactively developing local organizational capacity, ensuring technical and financial services available from the public and private sector, and focusing government agencies on carrying out suitable regulatory roles in basin water resources management.

The concerns of farmers, irrigation managers, water resource management agencies and other stakeholders need to be addressed to develop policies that will continue to receive broad support through a process of learning and adjustment. Institutions need to be developed so that benefits are not captured by a few people, but instead are equitably dispersed to the interests of all water users and other stakeholders.

If responsibility and institutional arrangements for financing major repairs and improvement are not well worked out, then farmers may be discouraged from investing in good maintenance, which may then threaten the sustainability and benefits of PIM reforms. As competition grows for scarce water resources, it becomes increasingly important to clarify and strengthen the access of farmers to water.

PIM is not a panacea. By itself, PIM cannot overcome adverse crop prices, drought, corruption, poor governance, highly skewed distributions of land and political power, or other problems, but PIM can strengthen the capacity of farmers to cope with such problems.

16.4 IRRIGATION AND POVERTY

Let us discuss some issues, which are directly related to irrigation and poverty. Irrigation is an important means by which poor people sustain and improve their livelihoods. Participatory irrigation management can enable the poor to have greater voice in decisions. Conversely if poor farmers are excluded and their interests are neglected, then irrigation development may disrupt livelihoods and increase inequity. Experience shows that participatory irrigation management offers important opportunities to empower the poor farmers in good governance and to provide benefits for the poor.

Irrigation impacts on poverty: Irrigation can affect the livelihoods of poor farmers in many ways. These include not just direct impacts on income, expenditures and nutrition but also other dimensions such as access to resources, social capital and the status that comes from being informed and included in making decisions. Some of the main ways in which irrigation may affect the poor include:

- Increased employment for agricultural labourers,
- Higher agricultural productivity for small-scale cultivators,
- Reduced vulnerability to drought and more stable yields,
- Multiplier effects on local communities from increased demand for agricultural inputs, processing of outputs and greater demand for other goods and services, and
- Lower food prices, including subsidies for the many poor rural households.

Making labor more productive: Examining the linkages between irrigation and the poor highlights the importance of how irrigation can help make poor people more productive. Just as increasing concern with basin management has shown the need to look more closely at water productivity, not just land productivity, "more crop per drop," concern for irrigation as a tool for alleviating poverty points out the importance of "more jobs per drop". Simply increasing yields may deliver gains to landowners which are capitalized into land values, while poor people only benefit if their most importance resource, their labor, becomes more productive.

Targeting: Government assistance to irrigation can do more help to the poor if it is effectively targeted. Untargeted assistance may help big landowners and urban consumers while providing fewer benefits for the poor. Geographic targeting to apparently poor and more disadvantaged locations may be appropriate in some cases. Asking the poor themselves about their priorities is an important starting point in identifying how participatory irrigation management can best help the poor. Community meetings, walkthroughs, participatory rural appraisal (which you have studied in Unit 1 of Block 1 of this course) and other activities should pay special attention to ensuring that the poor, both women and men, are included and able to voice their concerns.

PIM and poverty: PIM is often introduced as part of policies intended to reduce government subsidies to irrigation and increase beneficiary contributions to the costs of irrigation. The poor would only gain if improvements in irrigation performance and agricultural productivity are sufficient to offset any increased costs they must bear. Gate guards, laborers and others irrigation field workers may lose employment (or try block reform), so attention should be paid to reducing and mitigating labor impacts, particularly for poor workers. Greater reliance on local management may facilitate use of more labor-intensive methods for operation, maintenance and construction,

benefiting rural laborers. Further study and experimentation is needed to explore ways in which PIM can best help poor people.

16.5 GENDER AND PARTICIPATORY IRRIGATION MANAGEMENT

Efforts to promote participatory irrigation management create opportunities for improving women's participation and gender equity in irrigation management. Attention to gender roles can reduce the risks that gender biases and stereotypes lead to women being ignored, disadvantaged or marginalized. Attention to the influence of gender roles on irrigation management can make activities more effective, inclusive and equitable.

Women as stakeholders: Women use water as farmers, and in other livelihood activities. Changes in irrigation management may have very different impacts on women and men, and depend on women's roles as decision makers, landowners, wage laborers and unpaid family workers. Increased social and economic change in rural areas, particularly temporary labor migration and diversification in household livelihood strategies (e.g. "part-time farming") bring a need to adjust irrigation management accordingly. In many cases women take key decisions about irrigated agriculture, but cultural stereotypes may lead to such situations where their needs are ignored or misunderstood. In addition to irrigated agriculture, most irrigation systems do not only deliver water for field crops, but supply water for domestic use, whether washing and bathing in canals or using shallow wells which rely on irrigation water to replenish groundwater aquifers, bringing in a wider range of interests and stakeholders concerned with the management of irrigation.

Roles and rights: Women's access to and control over irrigated land is structured by whether they hold land rights on their own, jointly with husbands, or depend on husbands or male relatives for their access to land. The extent, to which women are included in community meetings and decision-making, expands or diminishes women's opportunities. Such participation is affected by general cultural norms and stereotypes, and by specific matters such as whether meetings are held at times and at places convenient for women. The availability of credit and other financial services may be crucial in opening or blocking opportunities for women to profit from irrigated agriculture.

Gender and PIM: Gender roles have an important influence on how irrigation is managed, and on who does or does not benefit from efforts to improve participation in irrigation management. Women are affected in multiple roles, growing crops, raising livestock, cooking, washing, bathing and other water uses. Women and men should be involved from the beginning and in all stages of activities to change irrigation management that affect their lives. These provide a foundation for ensuring that projects and programs include women and men and equitably address their concerns. Doing this effectively often means looking not just at water distribution and infrastructure improvement but also at how rights to land, participation in community decision-making and access to information, credit and other resources can help promote gender equitable development.

16.6 PARTICIPATION IN THE IRRIGATION SECTOR

The irrigation sector provides a rich source of experiences and lessons in user participation. Participation by farmers in system design and management helps to ensure the sustainability of the system, reduce the public expenditure burden, and improve efficiency, equity, and standards of service. Mobilizing support at all levels and establishing the participatory process, however, involves costs; it also demands

knowledge of the incentives facing each group of stakeholders and of the essential elements in building effective user organizations.

16.6.1 Benefits

Efforts to increase user participation have been spurred by poor performance in efficiency, equity, cost recovery, and accountability of many large irrigation systems managed by government agencies. Greater participation by farmers through water users associations has helped overcome many of these problems.

System performance: The overriding reason for increasing participation in irrigation is to improve system performance. Clear gains in efficiency and standards of service are achieved when design and management of the irrigation system are transferred to farmers. System design benefits from local knowledge, and farmers have the means and incentives to minimize costs and improve services. For example, irrigation user associations can reduce labor costs by paying lower wages than government agencies; local farmers can provide closer supervision of staff than distant agency supervisors; also breakages are reduced when farmers feel a greater sense of ownership.

Public expenditure: One of the most noted effects (although this has nothing to do with farmers' motives for participation) is the reduction in government staff and expenditure requirements caused by farmer management and contributions of cash, labor, and materials. Farmer associations have proved more effective collectors of user fees than government agencies. It is not unusual for farmers to be willing to pay more than the original user rates after transfer of the system to their control. Increased collection of fees, however, does not motivate farmer participation. Participation must also result in direct benefits to participants.

Sustainability: Building irrigation systems that are wanted, supported, and owned by users themselves provide the best assurance of sustainability. Physical and fiscal sustainability of the irrigation system beyond the project is enhanced when operation and maintenance costs are met from user fees rather than high levels of government subsidy.

Equity: More equitable organizational arrangements and water delivery have been noted when participatory approaches are followed. A contributing factor is the socio-economic status of the leadership, which tends to be closer to that of the ordinary member, involving more tenants and small farmers than in non-participatory systems.

Spillover effects: The transformation of water users from beneficiaries to partners in irrigation development can have a widespread impact as farmers become trained and organized. It can increase local ability to coordinate input supplies, for example, and to deal with other government agencies involved in rural development.

16.6.2 Costs and Risks

Establishing user participation involves costs in mobilizing field staff, training, and organizing farmers and carrying out socio-economic research. Subsequent savings in construction costs and higher loan repayment rates, however, usually offsets these additional costs.

A bigger problem can be the additional time needed to establish a participatory approach and get the project off the ground, especially in the absence of existing local institutions for cooperation. Developing farmer organizations is often a slow process. But once the participatory approach has been established, it is not unusual for participation actually to reduce the implementation period. The kinds of problems that typically delay the implementation of non-participatory irrigation projects, such as difficulties in negotiating rights of way or obstruction by farmers or local politicians may be avoided or solved through effective participatory processes.

16.6.3 Conditions for Success

The success of participation efforts in the irrigation sector depends on how well the project mobilizes support and builds effective farmers' organizations.

Mobilizing support: Participation changes but does not eliminates the role of government agencies in irrigation development. Building support from policymakers and agency staff as well as farmers and other water users is essential for successful participatory projects and involves paying close attention to the incentives relevant to each group. The greatest receptivity to participation is often found in crisis situations.

Project implementation rests ultimately with agency staff. Internalizing support for participation within irrigation agencies often involves structural changes to link agency budgets firmly to farmer contributions instead of government allocations and to promote a more service-oriented approach. Because agency staff typically come from engineering background and are not oriented toward dealing with farmers, incentives for them to support farmer participation need to be backed up by training programs. Study tours to farmer-managed irrigation districts can be particularly effective, not only for their demonstration effect but also in raising the prestige of participation, exposing staff to new possibilities, and the most important creating a bond among participants.

The strongest opposition to farmer participation is often encountered at the field level, especially when civil service unions are strong. When field staff perceives the proposed changes as a threat to their jobs and livelihood, these vested interests can retard or even sabotage participatory projects. Clear directives are needed from policymakers, supported by performance measures linked to bonuses and promotions, to encourage greater accountability to the farmers. The new ethos can only develop gradually. Sudden cuts in the status quo should be avoided, and the changes in composition of staff should be allowed gradually.

Building effective farmer's organizations: Teams of trained specialists acting as community organizers have proved to be the most successful catalysts in participatory irrigation projects. In cases of very hierarchical social structure and inequitable distribution of assets, it may be unrealistic to expect fully democratic local organizations. To control vested interests, the varying incentives for different categories of farmers should be identified and accounted for in project design (for example, in defining water rights), along with the resulting problems of achieving collective action.

Appropriate incentives are needed if farmers are actively to support the user associations that are essential channels for participation and to assume the additional costs in time, materials, and fees. The most important of these incentives are improved irrigation services and a voice in management decisions through a user organization that is fully accountable to its members. The support of farmers is most likely to be sustained and organizational capacity developed when they are involved from the beginning in decisions on system design and their organization has full ownership and management control of the system. It is essential, for example, that specialized staff be selected by and accountable to the farmer organization, even if they have been trained by government agencies.

To be successful, farmer organizations must interact constructively with government agencies and technical experts. This relationship works best when consistent rules and procedures are established and supported by government regulation for the turnover of responsibility to farmers throughout the project or sector. Building the necessary organizational capacity for this turnover involves training farmers for a variety of new functions, including basic literacy, accounting, how to hold meetings, how to deal with agencies with legal regulations, possibly even computer applications, and water management and operation of equipment.

Fundamental to meeting all these conditions is a strong and transparent legal framework for the organization from the outset, providing farmers with rights and benefits as well as duties and responsibilities. This framework should also be flexible enough to allow farmers to evolve their own organizational structure and to permit the organization's responsibilities to grow in line with its capacity.

SAQ 1

i) Define participatory irrigation management and its uses.
ii) How benefits from participatory irrigation management reaches up to the lowest order of poor people or farmers.
iii) List the benefits from participatory irrigation management to the people lowest in chain.
iv) Differentiate between PIM and IMT.
v) List the role of women in participatory irrigation management.
vi) List the benefits of participation of farmers in irrigation sector.

16.7 PARTICIPATORY IRRIGATION MANAGEMENT – INDIA

Much of the institutional and physical infrastructure of modern Indian irrigation can be attributed to British colonial rule over India. Although there was a significant irrigation infrastructure built by previous kingdoms and was in place prior to the19th century. It had been largely neglected by the colonial administration until the early 1800s.

The first renovations to the Grand Anicut of the Cauvery delta in Southern India, for example, initially consisted of desiltation and were only augmented with infrastructure in the 1830s through the efforts of Colonel Arthur Cotton. Similarly, in Northern India, restorations to an extensive Mogul canal network commenced in 1817 and continued into the 1830s.

In British India responsibility for public works (such as irrigation) fell primarily upon the top military authority, the Military Board, until the establishment of civil departments of public works in the1850s. Early irrigation construction at a large scale consisted largely of restorations to existing canals, some of which measured hundreds of miles in length, anicuts (irrigation dams), and weirs that had been built by previous kingdoms. As a result of this preexisting infrastructure, the colonial government's initial expenditures on irrigation centered only on canal restoration. With little capital expenditure costs, the British were able to bring a considerable revenue from the sale of water and taxation of land brought under irrigation.

At this early phase in colonial irrigation, there was no coherent or well-defined framework for irrigation policy. Irrigation was seen by the British government as a state responsibility and was centered largely on restoring and maintaining existing works. The profitability of irrigation, given the minimal need for capital investment and the gains from taxation, made it attractive.

The costs of irrigation continued to increase as problems of poor drainage arose near canals to which outbreaks of fever and malaria were attributed. A great famine from 1837 to 1838, however, demonstrated some of the benefits of irrigation, because only crops in the canal districts survived the drought. As a result, the colonial administration increased its expenditure on new canal construction, most notably with the massive Ganges Canal that opened in 1854 measuring almost 900 miles long and irrigating 1.5 million acres of land. This was, however, the first of India's canals to be built with borrowed money (from loans raised in London) and was a harbinger of the increasing investments and decreasing profits that the government was to reap from irrigation.

Between 1880 and 1900 there was a 60% growth in government-funded irrigated area. Although many irrigation projects were providing a reasonable return on investment (7% on average), the vagaries of weather and famine (two great famines from 1887 to 1888 and from 1899 to 1900 combined with dramatic regional differences in topography and soils) led the Irrigation Commission of 1900 to study more closely the benefits (in terms of revenue and risk protection against drought and famine) and costs of irrigation (Khagram, 1998).

The mandate and powers of irrigation administration in India since 1947 (i.e., from independence to the present day) are reflective of colonial experiences in at least four respects. Irrigation departments have been largely technocratic in emphasis with engineers occupying many of the top managerial and operational positions (World Bank, 1999). As a result, the irrigation agencies have done little by way of clarifying the relationship of government rights to customary rights, both in terms of rights over water as well as rights over land on which irrigation canals (Fig. 16.1) and distributaries are built.

Fig. 16.1: Outlet canal.
(Source: http://www.itczm.ait.ac.th**)**

Second, although the states retain primary responsibility for regulating water, there are very significant jurisdictional overlaps between states and the Centre Government.

This brings us to a third key regulatory feature, which is that rights over surface waters are poorly defined. Because all surface waters are public property under Indian statutory law, the government has the right to regulate, develop, and administer surface water.

Finally, a fourth key characteristic of the water regulation framework in India is that rights over groundwater are treated entirely separately from rights over surface water. Groundwater is defined as being purely private and is tied to ownership of land. Moreover, this means that resource access is biased not only in favor of landowners but also toward big farmers who have higher pumping capacities and deeper tube wells. Government control over groundwater has generally been very limited.

In sum, the history of colonial irrigation in India has been marked by large investments in infrastructure, both in major and minor projects. In addition, because of decentralization reforms, irrigation was seen largely as a responsibility of states and localities with the exception of interstate rivers and valleys. Independent India thus inherited a significant number of capital projects that fell largely to the state governments to maintain and expand as well as a system of rural water resource management in which states exercised monopoly power. Present-day irrigation arrangements continue to be characterized by state domination but with a major federal role in big dam projects as well as by a complex web of poorly defined surface water rights and privately held groundwater rights.

Present-day irrigation departments, like their colonial predecessors, continue to face problems concerning financial remuneration. Many state irrigation departments regularly face expenditures well in excess of revenues, although this may be attributable to numerous factors including internal inefficiencies and low (often flat-rate) water tariffs. The consequent pressures on irrigation departments to cut costs have resulted, in part, in the deterioration of irrigation infrastructure nationwide, especially of minor canals. Although governments at central and state levels have continued to

seek and appropriate funding for major projects such as the controversial Sardar Sarovar projects on the Narmada River, existing minor projects remain in disrepair.

Partly in response to fiscal constraints, there have been efforts by state irrigation agencies in recent years to transfer partial responsibility for the operation and maintenance of canal systems to local water users associations (WUAs) (Parthasarathy, 2000). For example, the Government of Gujarat established a PIM program in 1995, which is launched with 13 pilot projects to transfer irrigation management to users groups (Narmada and Water Resources Department, 1994, 1995). The state government allocated funds to subsidize the repair and rehabilitation of irrigation works to be implemented with the oversight of the Irrigation Department and, in some cases, of NGOs. The Government of Andhra Pradesh went even further in establishing the Andhra Pradesh Farmer Managed Irrigation Systems Act of 1997 that mandated that all of the states major, medium, and minor irrigation schemes should involve WUAs (a total of 10,292 groups). The government allocated funds for repair and maintenance of canals on a per-hectare basis, and it also initiated efforts to elect WUA representatives and to form federations of these associations (Van Koppen & Parthasarathy, 2001)

Although public opposition to big dams in India can be traced back at least to the Silent Valley Project in the Southern state of Kerala in the 1970s, few anti-dam struggles have garnered international attention at the scale of the Sardar Sarovar projects on the Narmada River.

The adoption of PIM in India is not without precedent in other parts of the world. Fiscal necessity has been a primary cause of the transfer of irrigation control from government agencies to users in Australia, Japan, the United State, and Spain. The growing emphasis on minor and medium scale PIM in India is also a result of a changing political climate characterized by increasing citizen dissatisfaction with major dam projects.

However, it is difficult to assess the PIM efforts and their progress in India. Irrigation departments in numerous states have indicated an agency-wide interest in pursuing PIM, not only for cutting costs but also for better meeting annual irrigation targets (Fig. 16.2). As of 1999, eight states had passed or were in the process of passing legislation on PIM, thus suggesting that the time was right for PIM.

Fig 16.2: Irrigation cannal system in India.
(Source : http://www.itczm.ait.ac.th**)**

16.7.1 Analysis: Institutional Preconditions to Collaboration

The issue of property rights is closely linked to regulatory frameworks concerning specific natural resources such as forests and water. It is useful to clarify what is meant by property rights and how they are relevant to the public administration of forest and water resources in India. The term *rights*, as used here, refer to the legal or customary claims to a resource or good. In general, customary claims over forests and

water (i.e., traditional community arrangements) have been subjugated to legal rights set through legislation.

The issue of rights is complicated when the resources at issue are *common-pool resources* (CPRs) – that is, "goods that can be kept away from potential users only at great cost or with difficulty but that are subtractable in consumption and can thus disappear" Such goods include forests, pasturelands, water resources, and any environmental sink over time. Although it is often difficult or costly to exclude people from using such resources, some form of resource management becomes necessary when the good is subject to over consumption, as is demonstrated by the decline in forest cover and groundwater resources in India.

Contrary to conventional wisdom, vague property rights are sometimes more beneficial for enabling collaboration than the clear rights. **Property rights over water are vague in India.** The setting up of common-property regimes, in which community groups share rights to water and trees with government agencies, can be expected to be more difficult in cases where public agencies would compromise their authority (and possibly their historical mandate) by sharing right and resources. A key initial challenge for agency-citizen collaboration thus lies in opening up spaces for negotiation between citizens and agency officials without immediately posing a threat to agency authority. Ironically, it is sometimes an ambiguity over property rights to a resource (rather than clarity about such rights) that can provide such an opening.

16.7.2 Implication for PIM

First, the ambiguity of property rights over surface waters suggests that there is some possibility for negotiation between irrigation departments and WUAs (Water Users Associations). Although agencies would likely to seek to retain ownership over canals and reservoirs, a turning over of the operation and maintenance of the canals is not likely to generate a conflict over the governments' rights of ownership.

In PIM, the basic orientation of irrigation and other departments remains intact although allowing for a substantial devolution of responsibility. Although PIM requires a significant shift in how irrigation departments perceive the capacities of farmers groups in managing water distribution (an necessitates the training of irrigation officials in community building skills), but it does not significantly alter the authoritative structure of irrigation distribution. The irrigation department remains in control of water in canals and reservoirs and is able to achieve its mandate of water distribution, albeit through semi-autonomous users associations. As such, although PIM is innovative in its organizational arrangement (Fig. 16.3) but does not pose any serious challenge to Government authority and control.

Fig 16.3: Water sampling and *in situ* measurement in the narrow canal. (Source: http://www.itczm.ait.ac.th**)**

The primary motivation for the irrigation departments to engage in PIM is the long term possibility of reducing their own financial costs while simultaneously increasing irrigated land area. In doing so, they hope to better fulfill agency mandates (through annual irrigation targets) at a lower cost. In the past, poorly maintained canals have led to poor utilization and thus a low return on investment. According to Shashidharan (2000), Gujarat State spends more than 450 million rupees per year on operation and maintenance, of which more than three quarters is used for salaries and wages of a large and inefficient workforce.

The threat of bankruptcy has forced the irrigation department to explore alternative and more efficient management approaches including PIM. In addition, allowing WUAs to maintain the canal infrastructure and possibly to build their own distributaries from canals may provide a way for irrigation departments to hand off the complex issues of equity and distribution to WUAs.

Finally, the fact the irrigation departments have no control over privately held groundwater rights means that canal irrigation must compete with groundwater irrigation in a broader water market. Groundwater markets are important to participatory canal irrigation projects in that they affect the price of water that WUAs can charge their members.

Commercial tubewells are also sometimes viewed by farmers as being more dependable, because they are better able to predict water quantity and timing than are WUAs that are subject to uncertainty in the behaviour of irrigation departments concerning water releases. Thus, improved collaboration between irrigation departments and WUAs presents opportunities for improving the reliability of canal irrigation and thus its ability to compete with commercial groundwater sources.

In sum, there appear to be numerous incentives and opportunities for collaboration between irrigation departments and WUAs through PIM. Although state irrigation departments hold primary rights over surface waters, these rights are exercised largely through the ownership of canal irrigation works that are intended to distribute water to farmers.

Since the 19th century, the emphasis of irrigation departments has been on the construction of irrigation works for the purposes of water distribution to increase irrigated land area and to mitigate famine. As such, opportunities for improving the distribution of water through WUAs do not conflict with the property rights, mandates, or regulatory and historical orientation of irrigation departments. Moreover, financial and performance pressures provide strong incentives for pursuing PIM. We hope in coming fifty years we will have successful Participatory Irrigation Management in India.

16.8 INTEGRATED WATERSHED MANAGEMENT FOR SUSTAINABLE PRODUCTIVITY THROUGH COMMUNITY PARTICIPATION

The watershed approach is, being increasingly used in various development programmes like water and soil conservation, erosion control, command area development, rainfed farming, reclamation of ravines and other waste lands. Land and water conservation, development and management are fully achieved by watershed approach. The hydrologic units are very important for development of water resources through major, medium and minor projects and water harvesting structures.

What is Watershed?

Watershed is a geohydrological unit of area that drains the run-off to a pre-determined single outlet. Flowing water as well as underground water forms the major components of the economy of the any nation. Watershed management envisages

systematic and scientific study and approach towards conservation, harvesting, proper utilization and safe disposal of flowing water from the moment it strikes the land surface in the form of rain.

For the protection of our natural resources like land, water, vegetation and livestock and their development programmes, watershed is taken as a unit of development instead of administrative or revenue unit.

Participatory Watershed Management

Effective and strong farmers groups are the foundation and central feature of successful watershed development programmes. In recent years organized efforts are being made for people's participation in natural resource management in South-East Asia. The primary aim of this activity is building strong farmers' groups, which will pursue watershed management programmes and also income generating activities ensuring women empowerment and development in the region.

Watershed Development

Watershed development involves:

(1) Water Resources
- Water resources generated, distribution and legal aspect organized;
- Construction of water storing structures;
- Land affected in the forest area due to construction of reservoirs, dams;
- Clearance from the appropriate authority;
- Legal aspect for ground water exploitation; and
- Flood water storage.

(2) Technical Issues
- Watershed conditions; and
- Technological package according to the watershed characteristics like geology, soils, land use, climate, state of land and environmental degradation.
- Package is simple and acceptable to the local people. They can maintain and manage after the development.

(3) Social Issues
- Land holding pattern, category of farmers – marginal, small, medium or big;
- Other people dependent on these activities;
- What benefits are they going to achieve through watershed development projects;
- Immediate employment opportunities equally available to every household, increase in their income; and
- Project would enable them for social and economic change.

(4) Legal Issues
- Land records updated;
- Revenue *patta* for the landowner;
- Area leased for other activities like mining, forestry etc.; and
- Cases under courts, etc.

(5) Conservation Measures
- Contour bunds, check dams, terraces, gully control, afforestation, diversion channels, grassed waterways, farm ponds and water harvesting tanks.

Prerequisites for Watershed Management

(1) Watershed Characteristics
- Soil and their distribution, physiography, Status of land degradation, land cover and land use, agro climatic unit.

(2) Water Resources and Use
- Seasonal water availability for drinking, livestock use;
- Water resources available in the area;
- Water bodies like ponds, lakes, tanks, wells and others; and
- Extent of irrigation.

(3) Ownership Pattern
- Land holding – various categories of farmers, agricultural labours and other human population dependent on village activities.

(4) Socio-economic Data
- Distribution of human population and livestock;
- Age-wise distribution of both men and women;
- Occupational pattern;
- Educational status of both men and women; and
- Expenditure pattern.

(5) Vegetation and Biomass
- Forest cover and their area and status;
- Dominant tree species, grasses and other shrub coverage; and
- Existing requirement of fuel, fodder and timber in the watershed.

(6) Agriculture
- Cropping pattern in an area;
- Crops and their varieties;
- Agricultural practices;
- Crops and their yields;
- Cost of cultivation of each crop; and
- Crop residue available for use.

(7) Livestock
- Category of livestock;
- Grazing facility; and
- Improved and irrigated green fodder available.

(8) Other Data and Maps
- Local institution and other infrastructure;
- Educational, medical, industrial, marketing, roads etc.;
- Land degradation map, contour map, soil map;
- Land use map;
- Projected land use map; and
- Location of the works to be undertaken.

Steps in Participatory Management

(a) Selection and identification of site of the watershed, its area;
(b) Resources assessment – land, water, forestry, humans and livestock;
(c) Identification of beneficiaries from watershed area;
(d) Inventory of the needs of the local population;
(e) Identification and analysis of problems;
(f) Identification of technological options and detailed discussion with the local people and their leader and also panchayat;
(g) Source of finances;
(h) Survey and project plan preparation and budgetary estimate;
(i) Activity schedule – training of local people;
(j) Commencement of programme and involvement of local population through employment and supervision; and
(k) Maintenance mechanism and responsibility of farmer groups.

Some important Case Studies from Watershed Management in India

Gopalpura in Aravalis in Alwar District, Rajasthan

Ralegaon Siddhi

Sukhomajri Project

Tejpura Project

In the coming section we will describe a successful story of people participation in Sukhomajri project.

16.9 THE SUKHOMAJRI-WATER SHED MANAGEMENT PROJECT: A SUCCESS STORY OF PARTICIPATORY APPROACH

Sukhomajri, a small hamlet of about one hundred families with average land holding of 0.57 ha, is located in the foothills of Shivaliks in Panchkula district of Haryana. It is at a distance of about thirty kilometers by road to the northeast of Chandigarh. A successful experience of participatory natural resource management, which has been proved to be conducive for bringing about socio-economic and cultural transformation of the village community, have been initiated by Central Soil and Water Conservation Research and Training Institute, Chandigarh. Until 1975, Sukhomajri had no source of regular irrigation. The entire agricultural land (52 hectares) was under rain-fed single cropping. Small land holdings (lesser than one hectare per family) coupled with frequent crop failures due to erratic distribution of rainfall, made agriculture least dependable as a means of adequate livelihood. Consequently, the people of Sukhomajri were forced to keep a large number of sheep, goats and cows to eke out a living. But, once the domestic animals, especially the goats and cows, were allowed to graze freely in the nearby hills, followed by indiscriminate felling of trees for fuel and other domestic consumption, the hill slopes, once covered with lush green vegetation, soon became bare and not even a blade of grass was to be seen.

Sukhna Lake to Sukhomajri

In the year 1975, the continuing problem of silting of the prestigious man-made Sukhna Lake in Chandigarh drew the attention of the Central Soil and Water Conservation Research and Training Center, Chandigarh.

A reconnaissance survey conducted by the Centre under the leadership of Officer-in-Charge, revealed that the major source of sediment was about twenty-six percent of the catchment area located in the close proximity of Sukhomajri and a few nearby villages. Sedimentation was caused by the erosion of the bare hill slopes that was caused by over-grazing particularly by goats whose rearing had been the traditional occupation of the Gujjars inhabiting the village.

Constituting of Village Society

The attitudinal change as manifested in the concept of 'social fencing', was strengthened through the constitution of a village society in 1979 called the 'Water Users' Association', which later emerged as "Hill Resource Management Society" (HRMS), duly registered. The HRMS discharges three main functions; (i) protection of hilly areas from grazing and illicit felling of trees, (ii) distribution of irrigation water from dams on payment basis and (iii) maintenance of dams, water conveyance systems and other assets. The sources of income to the society are: irrigation water charges, sale of bhabbar and fodder grasses from forest area, income from leasing dam for fish culture and, one time membership fee. With the increase in income, both from farm and dairy sector, the economy of the villagers has shown a quantum jump. The villagers have been spending part of their income for constructing houses and a part in acquiring assets and modern gadgets.

To address the problem the Research Center applied soil conservation techniques developed by comprising of mechanical and vegetative measures. This reduced the runoff sediment from the highly eroded Shivaliks at a spectacular rate from eighty tonnes to less than one tonne per hectare, within a short span of a decade. The vegetative measures consisted of planting of tree species like khair *(Acacia catechu)* and shisham *(Dalbergia sissoo)*, in pits and bhabbar grass *(Eulaliopsis binata)* at mounds of trenches, and also *Agave americana* and *Ipomea cornea*, in critical areas to protect the soil against erosion. However, all these measures for containing the sediment *in situ* did not succeed in the absence of the willing cooperation from the people of Sukhomajri, who depended for their sustenance on the resources available in the catchment area. Hence, to promote agriculture and water availability in the area earthen dams were constructed. This resulted in rainwater harvesting and storage that could be used by the villages for agriculture through out the year. The concept of social fencing gained wide recognition. The society agreed to protect the hilly watersheds from grazing and illicit cutting of vegetation and in turn, were allowed to cut grass to stall feed their cattle and collect dry and dead wood or pruned branches for their domestic fuel consumption. As a result, the forest areas, which had a desolate look in the beginning of the project, were covered with grass and trees within a period of 10 to 15 years. Grass production increased more than double in the same period (from 3.82 t/ha to 7.72 t/ha).

Rain Water Harvesting

At Sukhomajri, four earthen dams have been built between 1976 and 1985. These serve three main purposes; firstly, to check instantly the gully formation in agricultural fields and, thereby, effectively prevent silting through the erosion of soil; secondly, to store surplus rainwater from the catchment's area to be used later for irrigation after the withdrawal of monsoon and thirdly, rehabilitation of the catchments.

With the availability of irrigation water mainly for rabi crops and introduction of improved agro-techniques, there was manifold increase in crop yields both for kharif and rabi.

Change in Cattle Composition

Social compulsions, economic considerations, self restrain and availability of ample quantity of grass and fodder, both, from forest area and agricultural fields, brought about a dramatic change in the cattle composition in the village. Besides, barseem (*Trifolium alaxandrinum*) is now being grown over an area of 4 ha with an annual biomass production of 140 tonnes. This has given a fillip to the dairy sector and boosted milk production over the years.

Replicability of Sukhomajri Model

The Departments of Forests, Agriculture and Soil Conservation, the World Bank aided Integrated Watershed Development Project (IWDP), in the North-West Shivalik States, have already implemented hundreds of such projects in this region. To site an example, till 1996 the Forest Department Haryana built approximately 93 rainwater harvesting dams covering 53 villages and Department of Soil Conservation, Punjab, built about 70 such dams. The IWDP (Kandi Project) has adopted this model on a massive scale in the North-West Shivalik States.

Lessons from Sukhomajri

- Peoples' participation must be ensured right from the beginning of any project.
- The needs and the problems of the people must be identified at the outset.
- Unless a project is aimed at meeting their needs, solving their problems and mitigating their hardship, it may not succeed.
- Watershed Management Projects should have short gestation period. The benefits should available in shortest possible period.
- Constitution of a village society (HRMS) must be a pre-requisite before taking up such projects.

- The emphasis should be on sustainability and equity, i.e., all the common property resources must be available to all sections of the society.

Source: S.P. Mittal, Y. Agnihotri & R.K. Aggarwal, Central Soil and Water Conservation Research & Training Institute, Chandigarh.)

SAQ 2

i) List the major achievements of participatory irrigation management in India.
ii) What is watershed? And what are the major issues in watershed development?
iii) List the various steps in participatory irrigation management in watershed area.
iv) Describe other success stories of watershed- management.

16.10 WETLAND RESOURCES

Wetland is a comprehensive term used for landforms such as swamps, marshes and bogs and saltwater marshes. Wetlands may be defined as the areas that are inundated by water or where the land is saturated to a depth of few centimeters for at least a few days per year. You have also studied the scientific definition of wetland in an earlier unit of MED-006. We have already described wetland sites from India that were recognized as important wetland sites for conservation and are known as Ramsar sites. Their common feature is that they are wet at least part of the year and as a result have a particular type of vegetation and soil. Standing water creates a special soil environment with very little oxygen, so decay takes place very slowly and only plants with specialized roots can survive. You have already read about Ramsar sites in Unit 10 of MED-006.

A programme on conservation of wetland is under implementation by ministry since 1987. A total of 20 wetlands in 13 states are covered under this programme in India.

Three major components used to determine the presence of wetlands are **hydrology** or wetness, **type of vegetation**, and **type of soil**. Hydrology is often the most difficult to define, because some fresh water wetlands may be wet only a few days a year. The duration of inundation or saturation must be sufficient for the development of wetland soils, which are characterized by poor drainage and lack of oxygen, and for growth of specially adapted vegetation (Fig. 16.4).

Fig. 16.4: Rich and diversified wetland forest of India

Although wetlands occupy only a small portion of earth's land area, they play very important part in the biosphere. In the oxygen less soils, bacteria survive that cannot live in high oxygen atmospheres. These bacteria carry out chemical reactions, such as the production of methane and hydrogen sulfide that have important effects in the biosphere. Saltwater marshes are important breeding areas for many oceanic animals and contain many invertebrates. The dominant animals include crabs and shellfish, such as clams. Saltwater marshes are therefore an important economic resource. Over geologic time, wetlands environments produced the vegetation that today is coal. Beside this wetlands perform a variety of natural services for other ecosystems and for people, including the following:

- Freshwater wetlands are natural sponge for water. During high river flow they store water, reducing down stream flooding. After a flood they slowly release the stored water, nourishing low flows;
- Many freshwater wetlands are important as areas of groundwater recharge (water seeps into the ground from a prairie pothole, for instance) or discharge (water seeps out of the ground in a marsh that is fed by springs);
- Wetlands are one of the primary nursery ground for fish, shellfish, aquatic birds and other animals. It has been estimated that as many as 45% of endangered animals and 26% of endangered plants either live in wetlands or depend on them for their continued existence;
- Wetlands are natural filters that help purify water; plants in wetlands trap sediments and toxins;
- Wetlands are often highly productive and are a place where many nutrients and chemicals are naturally cycled;
- Coastal wetlands provide a buffer for inland areas from storms and high waves;
- Wetlands are an important storage site for organic carbon; storage is in living plants, animals and rich organic soils; and
- Wetlands are aesthetically pleasing places for people. (Holloway, 1991).

Wetland Management is done for Environmental protection (Fig. 16.5) for recreation and aesthetics and for the production of renewal resources. Stearns (1978) lists 12 specific goals of wetland management: that are applicable today:

i) Maintain water quality;

ii) Reduce erosion;

iii) Protect from floods;

iv) Provide a natural system to process airborne pollutants;

v) Provide a buffer between urban residential and industrial segments to ameliorate climate and physical impact such as noise;

vi) Maintain a gene pool of marsh plants and provide examples of complete natural communities;

vii) Provide aesthetic and psychological support for human beings;

viii) Produce wildlife;

ix) Control insect populations;

x) Provide habitats for fish spawning and other food organisms;

xi) Produce food, fiber and fodder, for example, timber for fiber; and

xii) Expedite scientific inquiry.

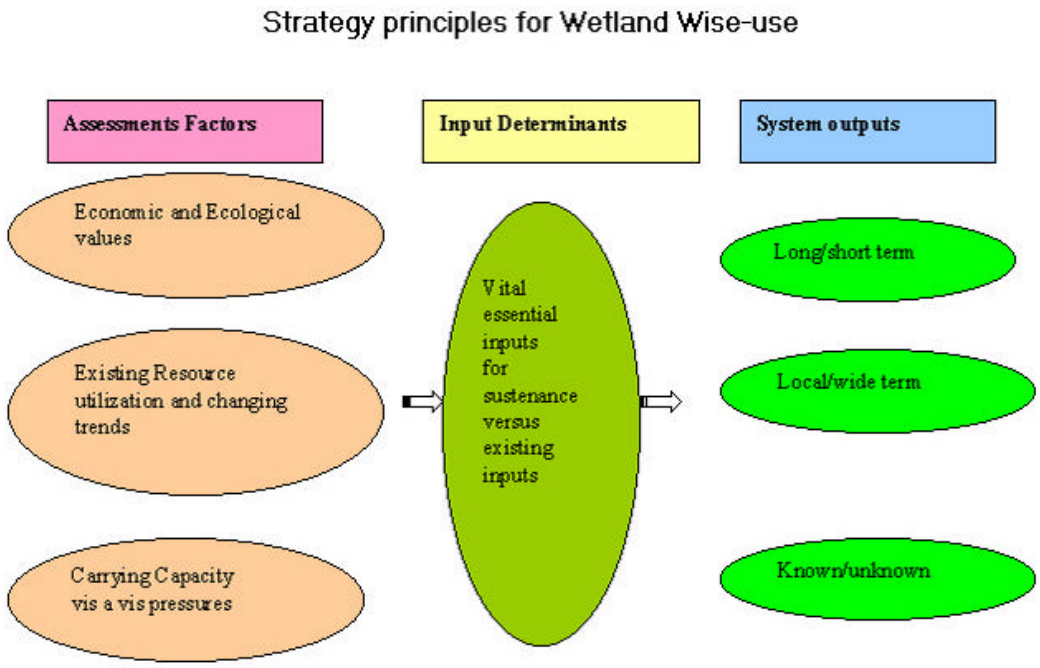

Fig. 16.5: Wetland Conservation Strategies, Polices and Mechanism.
(Source: EMCB -ENVIS Node of Water Resource Management.)

16.10.1 Reasons of Wetland Loss

Almost 70% of the world's population lives on seacoasts, and over much of the world river valleys and lakeshores have been settled since earliest. The communities established in these regions have often been attracted by the wetland system's easy access by land and/or water, level terrain, and high productivity. Exploitation of these features, even when leading the total conversion of wetland, has often brought social benefits, in both the short and long term.

Nevertheless, unacceptably high wetland loss had led to great loss to the biosphere in terms of resource loss and damage to environment. Many of these losses have been deliberate, but others are the result of decision taken in ignorance of the full value of the wetland in their natural state. Some are the result of inefficient management systems and others are unintentional byproducts of other actions.

- ***Limited information:*** some of the products and services of wetlands are sold; commercial fisheries, meat and skins from grazing herds, crops etc. but many wetland values do not have markets-water purification, storm surge protection for example. Recently when tusunami hit the coastal area, the area which have rich undisturbed mangroves were saved. Because these values are free goods they tend to be ignored in the economic calculations that decide whether wetlands should be conserved or developed. The result is a systematic bias favoring development and hence the degradation of wetlands.

- ***Distribution of cost and benefits:*** Sufficient information is available on the public benefits of wetlands conservation; even then wetlands are often lost because these benefits are not shared by the individual who owns the property. Private landowners frequently decide to drain their wetlands because they expect to earn more from growing crops and exploiting them than from leaving them in their natural condition.

- ***Deficient Planning concept:*** Point and nonpoint pollution are a frequent cause of wetland degradation. External factors such as runoff of agricultural chemicals and

soil erosion, together with point source pollution from waste treatment plants, have resulted in the severe degradation of estuaries wetlands.

- ***Policy deficiencies:*** There is increasing efforts to conserve wetlands, but several are still lost because of competing government priorities. The most common example of this is where, despite an explicit government commitment to wetland conservation, national agricultural policy favors wetland drainage.

- ***Institutional weakness:*** most countries have institutions responsible for managing wetlands. But only few pursue this mandate effectively. Among the many reasons for this, the most important is poor understanding of the true economic importance of wetlands and misperceptions of the nature of management problems.

16.11 INTEGRATED WETLAND MANAGEMENT

The 3rd Conference of Contracting Parties to the Ramsar Convention recommended in July (see Unit 10 of MED-006) 1987 that each country should develop a national policy for wise use of the country's wetland resources and provided following guidelines for the establishment of the national policies (also see Fig 16.6):

Box 16.1: Guidelines on the establishment of wetland policies.

Wise use involves the promotion of wetland policies containing the following elements:

a. A national inventory of wetlands;
b. Identification of the benefits and values of these wetlands;
c. Definition of the priorities for each site in accordance with the needs of, and socio-economic conditions in, each country;
d. Proper assessment of environmental impact before development projects are approved, continuing evaluation during the execution of projects, and full implementation of environmental conservation measures which take full account of the recommendations of this process of environmental assessment and evaluation;
e. Use of development funds for projects which permit conservation and sustainable utilization of wetland resources;
f. Regulated utilization of wild fauna and flora, such that these components of the wetland ecosystem are not over-exploited;

While detailed polices are being established, immediate action should be taken on:

a. Interchange of experience and information between countries seeking to elaborate national wetland policies;
b. Training of staff in the discipline which will assist in the elaboration of such policies;
c. Pursuit of legislation and policies which will stimulate wetland conservation action, including the amendments as appropriate of existing legislation;
d. Review of traditional techniques of sustainable wetland use, and elaboration of pilot projects, which demonstrate wise use of representative national and regional wetland types.

(Ramsar, 1988)

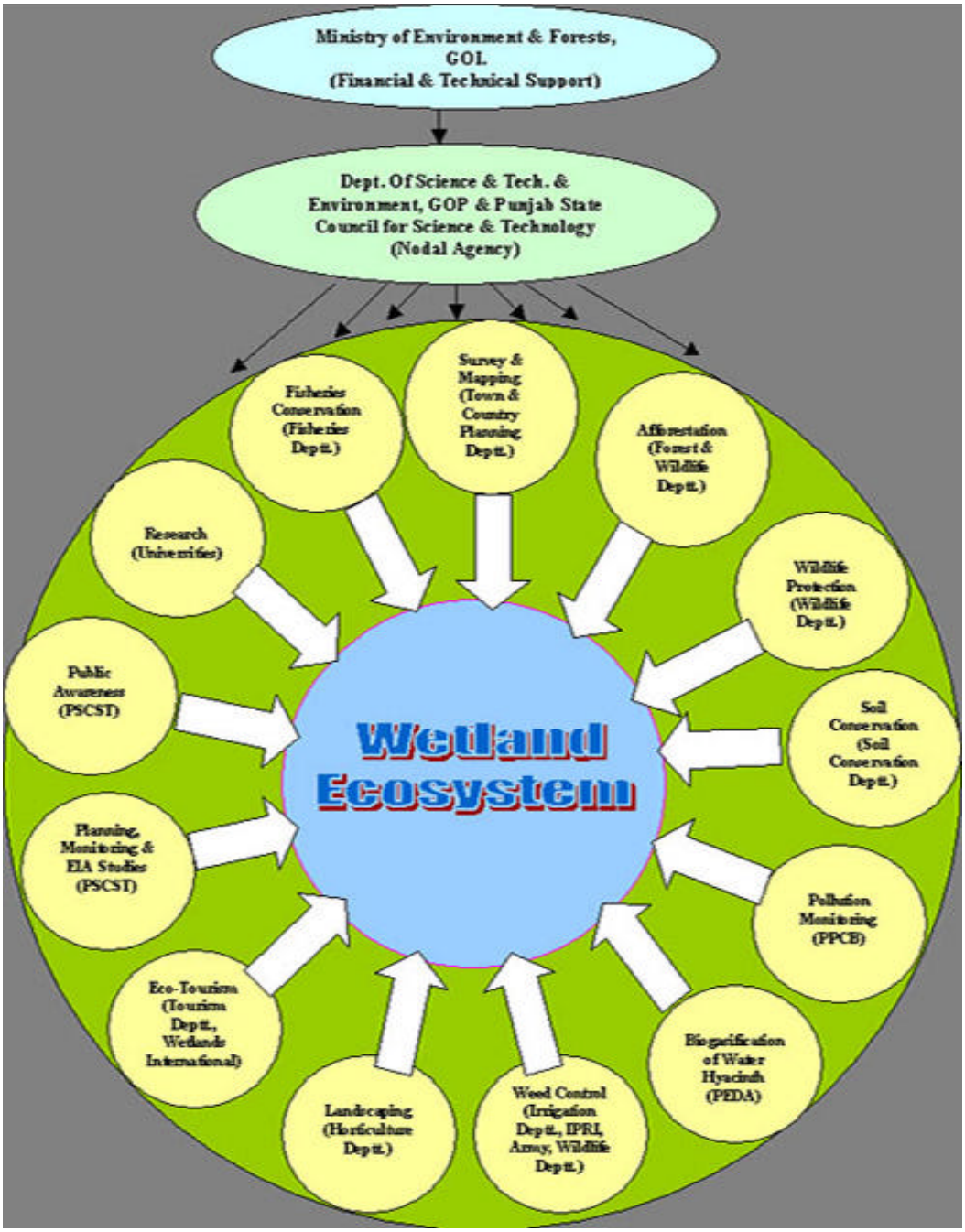

Fig. 16.6: Conservation mechanism of wetlands used in Punjab State Council of science and technology. (Source: EMCB-ENVIS Node of Water Resource Management.)

To mange the wetlands following steps should be taken:

- **Improving information:** people should understand why to conserve wetland ecosystem and species. Unless they are aware of the actions required to do so, the conservation would not take place. The quantity and quality of information on wetlands and their values must be increased and communicated more effectively to the people depended for livelihood on wetlands. A information programme to aware people will consist following four components:

  i) Assembling of national wetland inventory and classification;
  ii) Assessing wetland values;
  iii) Assessing the management potential of wetland systems; and
  iv) Wetland research.

- **Improving awareness:** understandings of wetlands values need to be built at all levels of Society. Three-audience merit particular attention:

  i) the general public;
  ii) local communities dependent upon wetland resources and the government departments; and
  iii) development assistance community, which make decision on investment in wetland conservation and development.

- There should be change in **agriculture policy:** which include agricultural price support to reduce conversion of wetlands into aquiculture land port etc.

- There must be change in **Water Policy:** including reducing impacts of water resources projects on wetlands.

- **Tax policy:** tax laws may provide partial incentive to wetland drainage. Wetlands could be conserved by changing these laws.

- **Wetland conservation policy:** the absence of specific national legislation limiting the use of wetlands outside protected areas has been important factor contributing to wetland loss. In recent years a number of countries have moved to make appropriate legislations.

- **Development Assistance policy:** a great deal of wetland degradation and loss is supported by development assistance funds whether grants or soft loans. To reverse this pattern, development assistance institutions need to pay more attention to the importance of wetlands and pursue polices which promote a more environmentally sensitive approach to wetland management.

- **Enhancing cross-sectional management:** the greatest obstacle to integrated management of wetlands in most countries is division of responsibility for wetland resource among several different agencies. The effectiveness of national wetland management efforts will be enhanced greatly by the establishment and effective operation of cross-sectoral structures. These may include specific ministries or department and interministrial committees and commissions. The success of such efforts will depend upon the capacity of the coordination between the widest possible range of institutions concerned with wetlands and to assist them in wetland conservation.

- **Improving human capacity to manage wetland:** substantial investment in training is required if wetlands are to be managed effectively.

Beside these regional and international cooperation is prerequisite for effective wetland management.

16.12 INTEGRATED WETLAND AND RIVER BASIN MANAGEMENT: A Case Study of Loktak Lake

Loktak Lake (Fig. 16.7) is situated 38 km South of Imphal city, the capital of Manipur State. The lake covers an area of about 286 sq. km at the elevation of 768.5 m located between longitudes 930 46' and 930 55' E and latitudes 240 25' and 240 42' N. Water level is shallow, the depth of which during dry season ranges between 0.5 m to 1.5 m. The total water spread area of about 490 sq km was recorded in 1966. Main water body of the lake is surrounded by shallow water, which stagnates over a marsh/swamp land.

Fig. 16.7: Loktak lake
(Source: www.bobbymaisnam.com/manipur **)**

The characteristic feature of the Loktak Lake is the presence of floating islands known as Phumdis. These are heterogenous mass of soil vegetation in organic matter, which occur in all sizes from a few centimeters to about 2.5 m. They occupy about two-third of the surface area of the lake. Free-floating plants, such as water hyacinth and partly decomposed roots and rhizomes contribute greatly to its development. The largest single mass of phumdis(Fig. 16.8) occupying an area of 40 sq km constitutes Keibul Lamjao National Park. The park is the only natural habitat of the most endangered mammal, the brow -antlered deer (*Cervus eldi eldi*)

Fig. 16.8: Loktak Lake with phumids
(Source: www.flamingotravels.com/ images/loktak_big.jpg**)**

Loktak Lake basin can be considered as a **sub-basin of the Manipur River basin**. It has direct catchment area of 980 sq km and indirect catchment of 7157 sq km. Out of the direct catchment area of 980 sq. km of the Loktak Lake; 430 sq km is under paddy cultivation, 150 sq. km of habitation area and 400 sq km of forest areas to the west and north west of the lake. The direct catchment area in the hills covers 96 hill villages with a total population of 21,334 according to 1991 census. The elevation varies from 780 m at the foothills adjoining the Central Valley to about 2068 m above mean sea level at peak.

A number of streams originate from the hill ranges immediately to the west of the lake and these streams flow directly into Loktak Lake. Of these, streams, a few major streams, Nambul, Nambol, Thongjarok, Awang Khujairok, Awang Kharok, Ningthoukhong, Potsangbam, Oinam, Keinou and Irulok contribute maximum silt load to the lake. The indirect catchment area covers catchments of 5 important rivers i.e. Imphal, Iril, Thoubal, Sekmai and Khuga and is spread over an area of 7157 sq. kms.

Loktak Lake is the largest wetland in the Northeastern region of India and has been referred as the **lifeline of the people of Manipur** due to its importance in the socioeconomic and cultural life. It plays an important role in the ecological and economic security of the region. The Lake has been the source of water for generation of hydroelectric power, irrigation and water supply. A large population living around the lake depends upon the lake resources for their sustenance.

The staple food of Manipur is directly linked to Loktak Lake. The lake is rich in biodiversity and has been designated as a wetland of international importance under Ramsar Convention in 1990. The Keibul Lamjao National Park, in the southern part of the lake, is home to the endangered Manipur Brow Antlered Deer, locally called Sangai. The lake has been also the breeding ground of a number of riverine fishes and continues to be a vital fisheries resource. It supports a significant population of migratory and resident waterfowl.

Manipur River Basin

The Manipur State has two river basins namely the **Barak river basin and the Manipur river basin**. The Barak River originates from the hills of the northern part of the state. It does not enter the Manipur valley. However it flows for some distance towards south and runs northwest and thereafter towards south through the hills of the Tamenglong district. The Manipur River arises in the north at Karong. It flows southwards of Imphal and is known as Imphal River. Along its course through the valley, downstream of Imphal, the riverbed of Manipur River slopes very gently.

The river has been regulated by two barrages for irrigation and hydropower. The Imphal Barrage downstream of Lilong regulates the flow for irrigation purposes while the second barrage at Ithai, diverts the river flow into the Loktak Lake for lift irrigation and hydropower project.

The important feature of the Manipur River from the hydrological point of view is the natural blockage of its flow in its lower reach. About 27 km. downstream of Ithai Barrage, after slopping down to 756.7 m, the riverbed suddenly rises by 8 m within a distance of 800 m and remains above 762.5 m for about 2.5 km. It reduces the capacity of Manipur River to discharge its flow.

The Manipur River system and its tributaries follow the N-S trends. They have a high degree of base level erosion. The Iril is the largest river in Manipur River system. The Iril and Imphal confluence have many swamp areas, which have now dried up. **Loktak Lake is located on the southern side of the river basin** (Fig. 16.9). This fresh water lake represents the lowest elevation of the valley. The major rivers did not fall in the Loktak Lake except few rivulets. This indicates the tectonic origin of the valley. All the rivers viz, Imphal, Thoubal, Iril etc. flow in a more or less N-S direction following nearly straight course. They also appeared to be tectonically controlled.

Fig. 16.9: Map of Manipur showing location of Loktak lake.
(Source: www.e-pao.net/epPageSelector. asp?src=fate_of_.**)**

The drainage pattern is controlled by the structure and lithology of the area. Different types of drainage pattern were identified in the area. Sub-dendritic sub-parallel and sub radial drainage patterns were commonly observed in the hilly terrain area. Meandering of river course are usually observed in the valley area such as Imphal, Iril and Thoubal River. The straight river course was suddenly twisted in the hilly terrain, which indicates structural control.

Land use

The total catchment area of Manipur River basin is 6,97,124.5 ha. Many different land cover identified are dense forest, medium dense forest, degraded forest, agriculture, jhum areas, water bodies, swamps and settlements. Degraded forest constitutes 31.1% of the total land area followed by dense forest (27.7%) and medium dense forest (14.8%). Agricultural land occupies 15.1% of the area.

Water Resources and Hydrological Regimes

There are several lakes, ponds and reservoirs in the Manipur River basin, which provide water for irrigation, domestic supply, power generation etc. The total area under water bodies is estimated a 14,875 ha which comprises 2.1% of the entire Manipur River basin. At present, there are seven river valley projects out of which three (Singda Dam Project, Thoubal Dam Project and Khuga Dam Project) are multipurpose, one (Loktak Lift Irrigation Project) is major and the remaining three (Khoupam Dam Project, Imphal Barrage Project and Sekmai Barrage Project) are medium irrigation projects. Manipur River Basin in 1996 has indicated the average runoff of Manipur River as 0.5192 million ha. m. against a total catchment area of 6,97,124.5 ha. Potential ground water is estimated around 44 million cu. m. per annum i.e. around 0.0044 million ha.m. (Department of Earth science Manipur university, 1996).

Developmental activities

In the basin, 50% of the domestic produce is generated from the agricultural sector. Water supply for irrigation is, therefore, of utmost importance in the basin. Command Area Development Programs has been carried out in the basin in the selected command areas of Loktak Lift Irrigation Project and Sekmai Barrage having cultivable command area of 24,000 ha and 5,000 ha respectively. Command Area Development Authority (CADA) was establish in 1982-83. The main objective of CADA program is to ensure irrigation water to every field in the selected command

area for the benefit of the farmers and for increasing agricultural production. The area under settlements has been estimated at 24,312.5 ha which represents 3.4% of the river basin. Out of this 5.3% is urbanized while the rest is rural.

Demographic features and socio-economic status

Manipur River basin has a total population of 13,94,398. The population is mostly confined to central Manipur valley.

The main crop is paddy followed by maize. As per the 1991 census the basin produces 225,550 tonnes of rice (82% of the entire state) and 6,020 tonnes of maize (52.8% of the state). The State Government of Manipur has several programmes to promote production of commercial crops like cotton, tea, coffee, rubber and sugarcane etc. Emphasis is also given on growing of crops such as pulse and oilseed using improved scientific methods.

Issues

Impact of human activities in the Manipur River Basin

Human activities often induce changes or accelerate the process of change. Developmental activities like construction of dams, barrage,etc., deforestation, shifting cultivation, uncontrolled use of fertilizers, etc. have degraded the river basin to a great extent.

The Loktak multipurpose project has caused both gains and losses in different aspects of the Manipur River Basin. Some of the salient impacts of the project are as follows:

- The impoundment of water by the Ithai barrage has inundated 80,000 ha of agricultural land besides some settlements in the southern Manipur valley;
- The populations of resident and migratory waterfowl, several fishes and macrophytes have sharply declined;
- The siltation in the Loktak Lake as well as in the valley has increased as the outflow of the silt-laden water has been checked; and
- The permanent water has caused thinning of the phumdi in the Keibul Lamjao area, the habitat of Sangai.

Siltation is another major problem the river basin is facing. The most important cause of soil loss from the catchment's area is the shifting cultivation. The landslides and the construction of roads in the hilly catchments also contribute to the soil loss. It is estimated that 6,72,650 tonnes of soil is lost every year from the basin.

Deterioration in the ecological health of the river occurs subtly and steadily. Further complications have been added due to variations in the water level of the flow, human pressure on land for agriculture and settlement and increase in landscape modification. Though there is only negligible inflow of industrial effluents, the organo chlorine pesticides from the surrounding paddy fields are another source of pollution in the river. Besides these, additional nutrients enter the river with the domestic sewage from the settlements especially the urbanized area of Imphal city.

Identification of threats and their impacts

Based on the analysis, the root-cause problems of the Loktak Lake are the loss of forest cover in the catchment area and the construction of Ithai Barrage. The degradation of the catchment area has led to the problems of siltation and increased flow of nutrients while the construction of Ithai Barrage have led to:

- changes in hydrological regimes thereby affecting ecological processes and functions of the wetland;
- inundation of agricultural lands and displacement of people from flooded lands;

- loss of fish population and diversity; and
- decrease in the thickness of phumdis in the Keibul Lamjao National Park thereby threatening the survival of Sangai deer.

The above root-cause problems have led to the following:

Siltation - Jhum cultivation, extensive deforestation and unscientific land use practices in the catchment area are responsible for deposition of approximately 336,325 tons of silt annually in the Lake.

Weed Infestation - The proliferation of phumdis (Fig. 16.10) and aquatic weeds have led to the reduced water holding capacity, deterioration of water quality, interference in navigation, and overall aesthetic value of the Lake.

Decrease in Power Generation - The decrease in water holding capacity due to siltation, weed infestation and proliferation of phumdis has reduced power generation capacity of the Lake.

Loss of Biodiversity - The populations of migratory and resident waterfowl has declined during the last few decades due to poaching and changes in ecological character. The habitat of Sangai deer in Keibul Lamjao National Park (KLNP) is also threatened due to thinning of phumdis and poaching. 35 species (5 mammals, 3 birds, 9 reptiles, 3 amphibians, 12 fishes, 2 molluscs and 1 annelid) that were reported to be abundant in the past have declined and are now disappearing gradually.

Decrease in Fisheries Production - Over-exploitation, indiscriminate methods of fishing, extensive growth of phumdis and weeds are responsible for decrease in fisheries' production. Construction of Ithai Barrage across Manipur River has interfered with the migration of fishes from Chindwin-Irrawady River system of Myanmar and consequently brought changes in the species composition.

Flooding - The construction of Ithai Barrage and decrease in absorption capacity of the Lake has resulted in inundation of the peripheral, agricultural and settlement areas.

Fig. 16.10: Weed infestation in Loktak lake, lots of phumids can be seen.
(Source: www.tribuneindia.com/ 2002/20020215/nation.htm**)**

Pollution - Inflow of organo-chlorine pesticides and chemical fertilizers used in the agricultural practices around the Lake, municipal wastes brought by Nambul river that runs through Imphal, soil nutrients from the denuded catchment area and domestic sewage from settlements in and around the Lake are responsible for deterioration of water quality.

Several other issues of concern are:

- Lack of community involvement in the conservation and development programmes;
- Encroachment pressures on lands created from dredged and excavated material; and fish pond encroachments into the Lake (related to decline in fisheries);
- Absence of policy and regulatory mechanisms at the government level for conservation of the Lake and its resources;
- Emphasis on engineering measures rather than integrated approach involving social, economic and ecological aspects;
- Inadequate technical and managerial skills and coordination among different agencies concerned with Loktak Lake management resulting in the emphasis on sectoral approaches leading to conflicting interests;
- Lack of awareness about the importance of the wetland in the local, national and international context;
- Absence of baseline data on hydrology, siltation, ecology, socio-economic aspects, catchments area, flora, fauna, etc. and their interrelationships; and
- Ineffectiveness of implementing agencies at different levels and lack of appropriate strategies and ineffective implementation of developmental programmes.

The Approach

Several measures have been taken by the Government of Manipur to check deterioration of the lake and to bring about improvement in the areas of power generation, fisheries, agriculture, and tourism and siltation control. All these measures are focused at the site-specific level without understanding its linkages with the overall processes and development within the river basin, which directly or indirectly has bearing on the lake ecosystem. Wetlands International-South Asia (WISA) in collaboration with the Loktak Development Authority (LDA), an agency of the Government of Manipur is implementing a project on Sustainable Development and Water Resources Management of Loktak Lake under India - Canada Environment Facility (ICEF).

Organizational and Policy framework

Loktak Lake is managed by various agencies within the State Government i.e. Departments of Environment, Forests, Wildlife, Irrigation, Agriculture etc. The Loktak Lake Development Authority (LDA) though responsible for coordinated approach interacting with several departments is working within the limited area of Loktak Lake. As such, a single unified agency with multidisciplinary and multi-sectoral approach has to be established to ensure sustainable development of the entire river basin. Wetlands International South Asia (WISA) and LDA are currently undertaking a project to develop and apply technical know-how for conservation and wise use of Loktak Lake involving local communities, NGOs, Government agencies, and research academic institutions. The main aim is to promote integrated management approach and to build up technical and managerial capabilities in LDA and other concerned agencies to address the issues of water management and sustainable development of Loktak Lake within Manipur River basin. All the tributaries directly or indirectly connected with River Imphal basin and contributing to quality and quantity of water in Loktak Lake will be thoroughly assessed for water management in the Lake.

The specific objectives and strategies of the project are:

- Control of soil erosion through afforestation, fuelwood and fodder plantation, regeneration of degraded forests, control or improve-shifting cultivation, engineering measures;
- Optimize water level in the lake through hydrologic modeling and interventions to

realize multiple values and functions of the wetland (power, wildlife, fisheries, flooding, water quality);

- Enhance water-holding capacity by hydrologic interventions at critical zones and improve flow and capacity;
- Improve water quality through control of nutrient input and pollutants from point and non-point sources;
- Sustainable fisheries development with emphasis on enhancing fish yield and diversity by developing mechanisms for fish migration and restocking;
- Conserve the endangered Sangai deer through habitat improvement of Keibul Lamjao National Park;
- Mitigate flood by rehabilitation of wetland processes and engineering measures; and
- Participation and development of local communities by their involvement in various components of the project and through alternative/additional income generation demonstration projects.

The strategies to be adopted highlight community involvement at all stages, from addressing the problems at the river-basin level; shifting the focus of the present approach of LDA from curative to preventive measures; and integration of social, economic and ecological aspects. This involves assessment of all stakeholder groups, current resource pattern, pressures and developing joint community-based demonstration projects to ensure participatory approach.

The first component of the project is data collection and capacity building involves through active participatory techniques and will lead to the establishment of accurate baseline data. A comprehensive information database is essential to support the other activities of the project.

Currently the data that is available on Loktak Lake in relation to various parameters including water management, socio-economic aspects and resource utilization pattern is sparse. The project envisages collection of data under all components including water management, sustainable fisheries development, catchment area treatment and community development.

LDA staff will undergo training for various aspects i.e. catchment's area treatment, water management and sustainable resource utilization. Human resources development activity especially within LDA, environmental agencies, NGOs and woman's organizations is important to ensure sustainable development and management of Loktak Lake in the future.

Water Management

Water Management Plan endorsed by the stakeholders which addresses multiple values of Loktak Lake e.g. for power generation, agriculture, wildlife and fisheries will be prepared. The main objectives of the plan include optimizing water level of the lake and the holding capacity, improving water quality and flood mitigation and developing mechanisms for implementation of strategies based on specific studies. It will also include plan of activities for water resource use, water availability, water allocation, flood control and operational mechanisms for implementation.

Specific Studies

The hydrology of Loktak Lake is complex and there are several issues, which need to be investigated thoroughly for formulating sound strategies for water management. While on the one side phumdis are proliferating resulting in choking of the Lake, on the other side decrease in thickness of phumdis in Keibul Lamjao National Park is threatening the survival of Sangai deer. Without adequate baseline data, the cause of degradation of the Lake ecosystem cannot be determined.

The role of phumdis in the hydrologic al functioning particularly, water-holding capacity, water balance, maintaining the desired thickness in the park and their proliferation in the Lake has to be precisely determined through scientific studies with concerned agencies.

Water Use and Allocation

The water management plan will clearly indicate the quantity of water to be allocated after analysis of water use and water availability. The project will;

- estimate water available in the Lake based on water balance and water holding capacity;
- identify stakeholder groups relating to water use by PRA exercises;
- determine water use by different stakeholder groups in qualitative and quantitative terms;
- identification of regulatory measures/legal obligations with respect to allocation of water; and
- estimate quantity of water for different uses like power generation, wildlife conservation, sustainable fisheries development and maintaining flora and fauna particularly endangered species.

Flood Control

The Ithai Barrage controls water levels in Loktak Lake during the dry season. Other barrages, such as the Imphal and Sekmai barrages, are used to control tributary water levels for irrigation. In general, flood protection is a downstream benefit with impoundment resulting in upstream flooding, as is the case for the Loktak lake area. The main activities within this component will be to identify every area, which are exposed to flooding; the operating regime for water control structures, flooding induced by the Ithai barrage and rehabilitation of wetland processes and engineering measures.

Monitoring

The plan will identify key factors, which should be monitored during and after the implementation of the plan. This is to ensure that the objectives of the water management plan are being achieved.

Catchment Area Treatment

The hill areas of Manipur, which constitute the catchment areas of important rivers, including Loktak Lake, are under pressure mainly due to deforestation, prolonged practice of Jhum cultivation and overall exploitation of resources. These factors have mainly contributed to the rapid siltation of the Lake and consequently have reduced its carrying capacity. One of the main objectives is to ensure people's participation at all stages in catchment development programmes through various mechanisms intended to ensure equitable distribution of intermediate and final forest products.

A preliminary survey was undertaken to identify the critical areas, which contribute to soil erosion leading to sedimentation of the Lake. Based on this survey, five sub-catchments have been identified which constitute the catchments for the major river systems entering the Lake. Two broad land use categories i.e. fallow land (upland with or without scrub having crown density less than 10%) and degraded forests (crown density 10-20%) have been delineated for soil and water conservation treatment purposes. Treatment for these areas has to be addressed separately with specific modifications at the different locations.

Biodiversity Conservation

The Loktak Lake covers a variety of habitats with rich biological diversity. Aquatic macrophytes comprising 233 species of emergent, submergent, free-floating and floating leave types have been reported in the lake.

Studies carried on the lake reveal occurrence of 32 species of phytoplankton and 55 species of zooplankton. The macrofauna include a number of vertebrate and invertebrate species, which inhabits the water body, Keibul Lamjao National Park, phumdis, islands and other habitats. A total of 425 species of animals (249 vertebrates and 176 invertebrates) have been identified from the lake. The vertebrate fauna includes 6 species of amphibia, 106 species of birds and 32 species of mammals. The total fauna diversity is likely to be much higher as many species have not been properly identified.

Of these, 34 species (five mammals, three birds, nine reptiles, three amphibians, twelve fishes, two molluscs and one annelid), which were reported to be abundant in the past, have declined and are now disappearing gradually. The fauna include some rare (e.g. the reptile *Python molurus*) and endangered species (e.g. *Muntiacus muntjak* and *Cervus eldi eldi*). At least one species of bird is reported to have completely disappeared. Brow -antlered deer (*Cervus eldi eldi*) is the most seriously endangered species, which inhabits the Keibul Lamjao National Park - its only natural habitat in the world. Keibul Lamjao National Park is the natural habitat of the most endangered mammal, the brow -antlered deer (*Cervus eldi eldi*) that is represented by about hundred individuals (WWF, 1994). Locally known as Sangai, this sub-species of deer was reported to be completely extinct in 1951, but a survey conducted under the auspices of IUCN revealed that only a few animals are inhabiting the park. Sangai are specially adapted to this characterstic-floating habitat, with their characterstic hooves unlike other deer species that help the animal walk conveniently over the floating islands.

Loktak Lake also provides refuge to thousands of birds, which belong to at least 116 species. Of these 21 species of waterfowl are migratory, most migrating from different parts of the northern hemisphere beyond the Himalayas. These migratory birds spend their winter (October to March) in and around the lake. In recent years it is believed that the waterfowl population, especially that of the migratory birds has gradually declined.

The fish fauna of Loktak Lake comprises 64 species. Two of these species are restricted in their distribution to the Yunan state of China, Myanmar and Manipur only. Loktak Lake serves as the breeding ground for several species of migratory fishes such *as Labeo dero*, *L.angra*, *L.bata*, *Cirrhinus rebd* and *Osteobrama belangeri*. These riverine species migrate from the Chindwin-Irrwaddy river system in Burma to the upstream areas of Manipur River and breed in various shallow lakes in the valley (Tombi Singh, 1991 a and 1993). In the past they accounted for about 40% of the natural fishery resources of the Manipur State. However, these fishes have disappeared from the lake since the construction of Ithai Barrage, which has blocked their migratory route.

Sustainable Fisheries Development

The fishery (Fig. 16.11) in Loktak Lake has traditionally been open water capture fishery, which accounted for 60% of the total fish production of the state. Migratory fishes from the Chindwin-Irrawady system of Burma (Myanmar) used to contribute about 40% of the capture fishery of the lake. The commissioning of the Loktak hydroelectric project, however, brought about changes in the fish and fisheries of Loktak. Migratory fishes have, since then, disappeared, while the State Fishery Department has been trying to compensate the loss by introducing millions of fingerlings of Indian and exotic major carps. Long before plans for the Loktak Hydroelectric Project were made in the 1970s, an area of 500 ha in the Takmu sub-basin was taken over by the State Government for intensive fish culture. At present, apart from the Takmu beel fishery, the lake is open to the public for natural capture fishery without the requirement of any lease or license.

Fig. 16.11: Traditional fisheries capturing in Loktak Lake.
(Source: cicmanipur.nic.in/ html/places.asp**)**

Aquaculture activities can be found in the peripheral areas of the lake, particularly along the inhabited islands such as Thangs and Karang, where local fishing communities have constructed fishponds (20 -30 m wide and 30 -50 m long. Several fish species including the major Indian and exotic carps are cultured in these ponds. The fishermen are provided with loans and subsidies from agencies such as Council for Advancement of People's Action and Rural Technology (CAPART) and National Association of Fishermen.

Lack of policies and regulatory mechanisms are the main causes of decline in fish production. More than 100,000 people on and around the lake depend for their livelihood to a great extent on the lake fishery, which is now a mixture of capture and culture systems.

ICEF has identified sustainable fisheries development as one major component of the project. The objectives will be to reduce impacts of different fishing methods and practices and develop mechanisms for fish migration, enhance fish yield and diversity and regulatory mechanisms to ensure sustainable development of fisheries in the lake.

Community Participation and Development

The communities living around the Loktak Lake can be broadly classified into three groups viz. (i) shore dwellers living in the periphery of the lake; (ii) hutment dwellers living in the lake on phumdis; and (iii) hillside dwellers living in the hills.

There are 55 rural and urban settlements around the Lake with a total population of about 100,000 people. The natural levees of Manipur River and its tributaries are densely inhabited. A large population of fishermen lives on some 688 floating huts of which many have been converted into permanent dwellings. It has been estimated that about 4000 people live in these floating huts for fishing activities. Apart from the people living in the close vicinity of the Lake, it has been estimated that about 1,21,000 people live in 546 hill villages. These people are largely under the control of tribal chieftains and practice shifting cultivation. The implementation of the project would help socio-economic uplift of the people by enhancing the Lake resources and overall environmental quality of the Lake.

The participation of local communities is crucial in planning and management of Loktak Lake on long-term basis. Ensuring participation of all stakeholders requires understanding of their needs and sharing of authority and responsibility for resource management according to arrangements, agreed by all parties. The process is lengthy and requires long-term commitment from all concerned stakeholder groups. In view of this, community participation and development has been identified as an important component in ICEF project.

The ultimate objective of co-management is empowerment of impoverished majority, promoting equity in the access to and control of resources, greater involvement of women, sustainability and system orientation.

Survey and Assessment

Participatory techniques were used to compile information on community structure, resources, demands, skills and indigenous potential, including seasonal changes and other relevant factors. Socioeconomic survey of the community living in and around the valley and the Lake was undertaken. In addition a baseline survey within Lake and its catchment area provide information on present resource utilization patterns and community development needs.

Capacity Building, Training and Networking

Capacity building of community based organizations and NGOs to develop skills for management of resources specifically related to the project was one of the major components of the project. Mechanisms for institutional development and communication networking were developed and training of local communities in nursery raising, hatchery management, restocking techniques, data collection, hydrology and minimization of wastes was to be undertaken. Awareness generating activities such as publication of newsletters and posters, organizing workshops and seminars is underway.

Joint Community based Demonstration Projects

Several joint community based demonstration projects have been planned under the ICEF project. They involve the establishment of hatchery, introduction of proper fish harvesting techniques, waste treatment and sanitary improvement, utilization of Phumdis, cottage industry involving local handicrafts, integrated farm management and plant nurseries.

Pilot projects to encourage the local community to resort to alternate sources of employment such as working in rice and oil mills would also be explored. Such programmes would greatly help reduce pressure on the Lake.

Lessons Learned

In the past all development activities i.e. within the Manipur River Basin was focussed to contribute to major needs of the Manipur District community. However, this needs to change i.e. to also consider the ecological needs of the Manipur basin and the Loktak Lake.

The major cause of ecological problems in Loktak Lake is due to improper planning and lack of integrated approach when developing projects. Efforts taken by the Government of Manipur to identify issues which lead to deterioration of Loktak Lake is a major step to increase the awareness on the ecological deterioration of the lake. Establishment of a Lake Development Authority as a single management body is a major step towards promoting holistic management of the lake. The project highlighted the importance of involving community at all stages of development, which is an important aspect within integrated management of river basin.

SAQ 3

i) Describe the importance of wetland in maintaining a particular type of flora and fauna.
ii) What are the major components of wet lands?
iii) How can people contribute towards conservation of wetlands?
iv) Define wetland and list various resources we derive from them.

16.13 SUMMARY

Let us summarize what we have studied so far:

- Water is essential for life of human being and other organisms.
- Water exists in substantial quantities on earth but human activities are continuously affecting water resource both quantitatively and qualitatively. Effective use of water and associated resources is essential.
- Around 40% of the world's food crops are produced by irrigated agriculture. The performance of irrigation and drainage is critical to the food supply and to farmers' incomes, as well as to the environment.
- The ultimate goals in managing irrigation water are efficiency, equity and sustainability.
- Efficiency has been achieved if every drop of water has been properly allocated and used, without any waste.
- The goal of equity means that water is fairly distributed among users. Some farmers may have an advantage over others. Those at the head of a canal have an advantage over those living downstream, as they have first access to water.
- In some cases, ideals of efficiency and equity may be in conflict. The goal of sustainability means that the users of today should maintain the quality and quantity of water resources for the use of future generations.
- South Asian countries are agricultural countries where agricultural land is predominantly irrigated. Irrigation management requires efficiency, equity and sustainability, which is only possible by participation of community in the development of irrigation plans. PIM in India, has post colonial history.
- Wetlands are destroyed and converted to agricultural land due to lack of information for immediate benefits. The wetland conservation should include information and awareness raising programme for public and decision maker, change in agricultural, tax and water policy, enhancing institutional effectiveness and community participation.
- Study of Loktak lake in India highlights the importance of involvements of people at every stage for sustainable development.

16.14 TERMINAL QUESTIONS

1. How participatory irrigation management does helps the poor farmers and the government?
2. Management of irrigation system in India by the farmers will be more fruitful. Discuss.
3. Discuss various problems associated with participatory irrigation management.
4. Discuss the role of women in participatory irrigation management.
5. List at least ten important wetlands from India and try to locate them on the map.
6. Describe the natural services the wetland does for other ecosystem.
7. List the specific goals of wetland management.
8. Describe the various reasons for the wetland loss.
9. What are the advantages of participatory management of water?
10. What values should guide the choice of a management model for water resources in a country or in a community?
11. What do you think happens when private sector manages water in the developing World?

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