

Table 1.

Crop	Water required (mm/crop period)	Crop yield (t/ha)	VWC [†] (cubic m/t)	Global average VWC (cubic m/t)
Sugarcane	1101	69.0703	159	175
Paddy	852	2.9892	2850	2291
Wheat	438	2.6482	1654	1334
Sorghum	320	0.7895	4053	2853
Millet	264	0.8075	3269	4596

[†]VWC, Virtual water content. Source: Chapagain and Hoekstra¹.

come across a range of estimates of crop yield and water requirements for sorghum. The yield for sorghum varies from 400 to 1200 kg/ha and virtual water content is found to vary from 400 to 4100 cubic m/t. There are similar variations in the estimates of yield and virtual

water for pulses and oilseeds. Thus, we are of the opinion that it is high time that the virtual water estimates for various agricultural products are computed state-wise or agro-climatic zone-wise. This can be done easily provided requisite data are available.

We are in agreement with the views of the discussor regarding crop diversification. The present practices with little or no regard to the implications on water resources are leading to rapid lowering of groundwater levels at many places and are not sustainable.

1. Chapagain, A. K. and Hoekstra, A. Y., Water footprints of nations. Value of Water Research Report Series No. 16, UNESCO-IHE, Delft, The Netherlands, 2004.

VIJAY KUMAR*
SHARAD K. JAIN

National Institute of Hydrology,
Roorkee 247 667, India
*e-mail: vijay@nih.ernet.in

Science in the wilderness

This note is with reference to the article titled 'Science in the wilderness: The predicament of scientific research in India's wildlife reserves' by M. D. Madhusudan *et al.*¹.

The issue of scientific inquiry in wildlife reserves is undoubtedly gaining momentum in recent years. From the time when scientifically conducted wildlife research was unheard of (pre-independence) it has certainly experienced a tremendous leap forward with at least the major species (large mammals especially) been studied in the last 40 years². For the authors, who have put in their past experience of fieldwork in the paper under reference, it is indeed worth the effort that will have a long ranging impact if not a pathbreaking one.

Without denying or putting forth arguments just for the sake of argument, it would also be necessary to ponder over the difficulties and challenges that a protected area (PA) manager faces within the wheels of this huge and efficient but perhaps a little rusted machine that we attribute to as the Government. If the authors have addressed the 'why', I would also like to bring to attention the 'how' by which the processes can be streamlined.

The entire debate emanates from the Wildlife Protection Act 1972, which is

even today perhaps one of the best legislations for wildlife conservation in the world. A look at the various wildlife enactments from across the world indicates that no other country has such an exhaustive legislation that covers the entire gamut of biodiversity². It is fairly recent enacted in 1972, and has seen several amendments, the most recent one being in the year 2006 (with recommendations of the Tiger Task Force) which has enabled the constitution of the National Tiger Conservation Authority, thereby reinstating the Government's willingness to change according to the times. The policing roles have been defined and as compared to the Draconian laws such as the Indian Penal Code, 1860 which is used against criminal offences, it is still the best for the penalty it imposes for a crime within the scope of the Act. True, it is more prohibitive in nature rather than permissive, but that is the way legislations are meant to be. Moreover, the scope of the Act is to cover a wider and generalized theme leaving much to be interpreted at the state level. This is a blessing in disguise, because it enables the implementer (the state forest department) to suitably adapt the Act according to the local and currently prevailing conditions (e.g. Declaration of Sanctuary, National Park, Conservation and Com-

munity Reserves under Section 26A and Section 35, Section 36A and Section 36C respectively). Also, it provides enough safeguards in the form of Section 26A(3), Section 33 and Section 35(5) and (6) which essentially prevents any alteration to protected area boundaries, permanent construction and other such activities by the state without the prior approval of the National Board, the highest advisory body headed by the Prime Minister of the country himself. This has given enough protection over political interference at the local level such as in autonomous councils, unclassified state forests and community-owned forests, particularly in the northeastern region of the country.

Within this context, research is also entirely the mandate of the State Government (Section 28), but the Act also envisages the constitution of a State Wildlife Advisory Board and advisory committee Section 6(l) and Section 33(b) respectively, which has members none other than the Chief Minister, members of the state legislature, representatives of NGOs, ten eminent people with contribution to conservation science and representatives from ZSI, BSI, WII and others.

Besides these, a Research Advisory Committee is also constituted in several states (e.g. Assam) wherein the research proposals submitted are examined. It has

been observed that in most of the cases, procedural formalities were not being followed, which resulted in rejection of a proposal. Too much of paperwork, red tape and long processing time is considered a bane to modern science and the scientists adopt shortcuts. The conflict of interest surfaces when they are caught.

Whether research alone has been able to bring about wildlife conservation is something that needs to be examined in the geopolitical scenario. Nepal, which had always been more accessible to research, is now facing a severe threat in some of these intensively studied areas. Again, one cannot put two and two together, but it reiterates the stand that the law with all its impediments has alone been able to protect the National Parks and Sanctuaries. The Protected Areas in India roughly fall under the IUCN category II of National Park: Protected area managed mainly for ecosystem protection and protected areas meant for recreation and includes all natural areas of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

Though strictly not followed in spirit, it recognizes the sheer biological diversity of these natural areas and also perhaps underlines the theme of 'fortress conservation and preservation' and that 'nature knows best'. Therefore, research, which in any way interferes with these natural processes, will fall under the same scanner.

The second issue of concern is research overlap, meaning extensive over research or rather the lack of it. It is true that there are multiple agencies investigating multiple questions but a biodiversity study that encompasses all, is slightly confusing. There are parks that have been extensively studied because of their biological importance, park manager's friendliness or sheer proximity to a research institution or to a centre of policy makers (e.g. Delhi, Chennai) while some have almost been neglected in spite of being equally important if not more. It is rather impressive that India is a leading example for con-

servation and research with the institutes already mentioned, but it is baffling to see that research for an Institute A always begins on a clean slate rather than carrying it forward from the point of what has been already done, by say, an Institute B in the same region. It is like reinventing the wheel, and this is an issue, which can easily be handled by the research community themselves.

Research is also donor-driven as so would be conservation in a developing country like ours. I am not sure whether the era of charismatic species has ended but it is often the use of such terms along with biodiversity conservation, alternative livelihoods or sustainable development that drives a research objective. Not to mention the larger gamut of millennium development goals and the trends that govern global economy and markets. It is nevertheless sad but true that these trends at the global level do impact research work at a local level. It is more than often that the research questions are imposed rather than emanating from the needs of the park.

A general complaint most often heard is that the concerned researcher never puts in a copy of the research findings to the concerned PA authorities. Even if it is done, it is more of a formality because in most cases, the project is over and the researcher and the park manager who was present during the time of research has possibly moved on. The results are sent by post rather than making any sincere efforts into putting the findings into practice. Agreed, that fundamental research cannot be necessarily translated into practice but if it is able to come out of peer reviewed journals to the common man then surely it is worth all the hard work. Perhaps it is the need of the hour that these renowned institutions train the researchers in PR skills and in the process popularize science as well.

Fundamental research, as many would say, is still the need and it would be unfair if one does not include the foresters who would have toiled in the field that way. D. Brandis, E. P. Gee and Jim Corbett, to name a few in the bygone era, are people who have protected and also popularized science to a great extent. Pugmark census and control burning are few of the techniques that have emanated from a foresters diary. Kanha, Great Himalayan National Park, Nagarhole, Bandipur and

Kaziranga National Parks are some of the best-protected areas because of the dedication of field level workers and their zeal in putting that extra effort. Yet, the irony remains that there has not been a single long-term research work in Kaziranga National Park so far!⁴.

Red tape is everyone's favourite word, but it is also true on the other side. Political interference, manpower management and the constant need for basic infrastructure are a few things, which drain out a forester working in the field, and fundamental research comes as the lowest priority. The Indian Forest Service is now more than 100 years old with strength of 2500 odd officers³. If the free and fair system of selection and 3 years of rigorous training is to be believed, then by recruiting the so-called best of the science graduates it has chosen the few who at least have the intention to bring about a change in the system and love their natural surroundings. Trends in the past years recruits show high levels of education including several doctorates from the very institutes which sends researchers to these PAs and also imparts professional training to foresters at various levels of their career. So if the cynicism or so-called apathy develops in the same foresters then there is a fundamental problem of understanding of the way in which the system operates.

Let us admit that the practitioners and professionals of conservation science are the spokes of the same wheel. It is only a humble submission that there is a positive approach to help each other constructively so that the machine moves on.

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1. Madhusudan, M. D., *Curr. Sci.*, 2006, **91**, 1015-1019.
 2. websites: <http://www.seaworld.org/infobooks/Endangered/eslV.html>, http://www.birdlife.org/action/change/europe/habitat_directive/eu_wildlife_laws_eng.pdf
 3. <http://www.envfor.nic.in>
 4. Vasu, N. K., Management Plan of Kaziranga National Park, Govt of Assam, 2003.
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SONALI GHOSH

*Divisional Forest Officer,
Social Forestry Division,
Kokrajhar 783 370, India
e-mail: ghoshsonali@gmail.com*