

Some early & little-known facets of Wind Power development in India.

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Early Years

Dr.P.Nilakantan, the founding Director of National Aeronautical Laboratory pursued development of wind power in the early fifties. By 1958/59 NAL had actually deployed 70+ water pumping windmills (Figure 1) in various parts of the country. That was an initiative that was too much ahead of time to make sense to public. As a matter of fact, they had even a test station for small wind turbines.

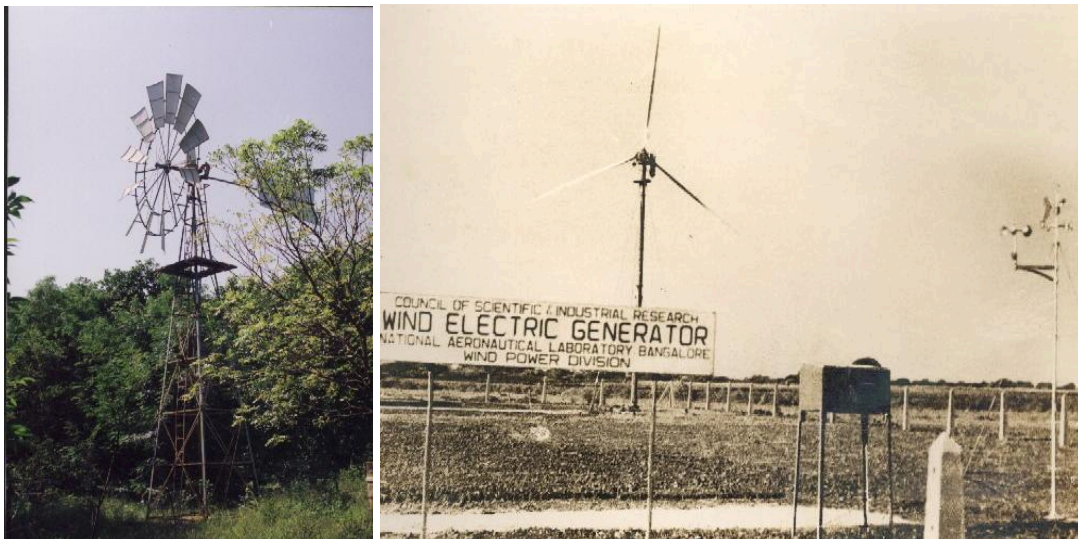


Figure 1 NAL developed wind machines in 1960's

They naturally looked at the available meteorological data in India and tried to create a wind map (figure 2) and had in fact some rough idea about windy areas.

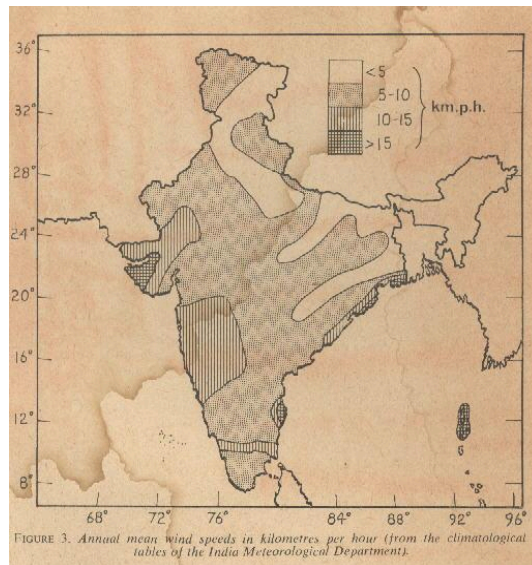


Figure 2. First wind map of India produced by NAL Scientists in 1958/59.

This map was based on the meteorological observations from IMD's network of observatories which were few and far apart. At the same time they had recognized that it was not practical to depend just on IMD records when it came to wind energy. In 1954, the founding Director of NAL had, in a UNESCO conference at New Delhi demonstrated that while planning to harness wind as a source of power one had to go beyond India Meteorological Department's observations (See box 1).

Box 1

The topography of any area is an important factor and it sometimes happens that fifty miles within a station that is apparently very calm throughout the year we may have one of the windiest places in the Peninsula. A typical case is that of Trivandrum that shows an annual average hourly wind velocity of only 4.4 m.p.h. But near the "Aruvamozhi Gap", about fifty miles to the South-East, wind velocities of the order of 30 miles per hour prevail over a considerable period.

Extract from TN-WP-9-62: Some Considerations in the Choice of Areas for Preliminary Wind Power Surveys in India by Dr. P. Nilakantan: Paper presented at the UNESCO/NISI Symposium on Solar Energy and Wind Power held at New Delhi, October 1954

The research mode approach to wind power came to an abrupt end when the laboratory had to concentrate on aerodynamics pertaining to Air crafts and Space technologies. Wind Power development was discontinued after this major shift in the laboratory goals till 1977. When the second oil shock came upon the world, almost everywhere there was a renewed interest in wind as a source of power.

NAL continued to be probably the sole repository of any engineering knowledge on windmills in India in the early days. Some experimental wind mills and wind chargers were developed. With Government concentrating on wind mills, a test station was also set up at NAL where some small

windmills were set up and mostly their endurance levels were checked out. The focus was shifted to discovering new windy sites. By early eighties NAL had conducted long term wind surveys for Karnataka Government and at this time under the guidance of Dr.S.K.Tiwari (SKT) (figure 3).



Figure 3. Wind monitoring station in Talacauvery, Madikeri district set up in 1981

At this time SKT and Miss Anna Modail Mani (Ms.Mani) retired from IMD started discussing a possible wind measurement program to be launched across the country as both of them had clearly understood the pit falls of depending on IMD data. These thoughts found an echo from the then Department of New Energy Systems (DNES) got into a rethink about the lack of data. The result was that Dr.J.Gururaja and his young and dashing assistant Ajit Gupta got Ms. Mani on board to conduct a wind specific survey and SKT became the natural choice for site selection and as his assistant I took up the implementation end to end. Most of the administrative difficulties were addressed by the pure charismatic power of Miss Mani. She set up a Field Research Unit (FRU) under Indian Institute of Tropical Meteorology (IITM). Dr.S.K.Tewari and myself were appointed as consultants to the project of setting up 20 m tall masts in initially four states (Karnataka, Tamilnadu, Andhra and Maharastra). The choice of mast height and instrumentation has come under much criticism in the last decades without understanding that the turbines in the initial years were much smaller with hub heights ranging 18 to 30 m. It will suffice to say that in the eighties the whole concept of using solid state datalogging equipment in remote areas, where one had to walk for kilometers, climb hills that had leopards and other wildlife to reach the site needs to be understood in right perspective. For carrying out foundation work we had to carry head loads of concreting material, water and other materials manually. To shift mast materials on occasion mules had to be employed. For collection of EPROMs from the data loggers we had to send a team of at least four people because of the fear of wildlife attack. There was practically no data based on which any wind power related work could be undertaken.

NAL's hands on experience with extended measurement campaigns in remote areas came in very handy. Miss Mani, herself an accomplished instrument designer saw the merit and readily agreed with the way NAL approached the project. The first wind monitoring station under this program was set up at Sultanpet near Coimbatore in Tamilnadu (Figure 4). Miss Mani witnessed the entire process sitting under an umbrella. Such was her commitment and leadership.



Figure 4. Installation of the first mast under National Wind Monitoring program in 1984

In the first phase of this project 36 monitoring stations were established in four states. Then more states were added and by early nineties, first volume of wind data for India was published by IITM (FRU) and there was no turning back from then. With turbine heights growing, the program started using taller masts, more and more sophisticated instrumentation. For the initial years of development this program provided the very basis. Even to this day this project is continued by NIWE with latest of instrumentation and capable of remote online access. Of course the IEC compliance, on line data access and all modern day demands are met with.

Micro Survey reports:

In early nineties there was a national level effort to create an Indian Wind Atlas. Quite a few international agencies got into this but finally the program never took off. In those days the global weather modelling techniques were just being developed and confined to the rarefied scientific environment in agencies concerned with weather research with little connection with on the ground requirements. Some advanced countries did have their own wind atlases and there was certainly some peer pressure coming on. However, there was no governmental entity that could be entrusted with this task. We must remember that we had to work with Survey of India maps and very little on site data and there was no Google Earth! Global Positioning Systems had just entered commercial space, and they could not be used with SOI maps as they had different projection systems.

Then two major factors influenced the next steps. One was development of PC based wind analysis programs started appearing in the market and they were very primitive. It was also a time when personal computer (PC) was becoming more and more popular as compared to main frames.

There were three (could have been more, difficult to remember now) programs were in market.

1. MS Micro – Mason & Sykes model that could be run on micro computers
2. NOABL – a program from NREL that could also be run on micro computers

3. Windfarm & Windfarmer
4. WAsP – A wind flow model from Riso National Laboratory

At NAL we tried all of them. MS Micro came with 14 floppy disks (360 kB, 5 ¼"). The disks would be corrupted by the time they reached us from Canada. They sent the replacements promptly several times. Finally when we got the program working, its outputs were very coarse to be of much use. Input data creation was nightmarish. NOABL again came with practically no help files or any recourse to any consultation. One has to understand that European, particularly the Danish influence on wind power development was very strong in those days. WAsP developed by them was one of those relatively easy to use model. Presently it is perhaps dismissed as an overly simplified linear model by modern wind analysts. But it did give reasonably good results when used with care. Creating contour maps was laborious but not too complicated. Above all, they had set up some kind of a back office with real people reading your emails and trying to resolve any issues put up to them. In 1996, I wrote to Dr.Lars Landberg who was heading WAsP development at that time and asked if he can think of conducting a training workshop in NAL in Bangalore. Luckily, he readily agreed. Subsequently I was able to organize a training program for 24 people at a very nominal cost. Lars Landberg and Niels Mortnesen came under DANIDA funding. It was still an era of DOS computer – I think it was 80286/386. So we went ahead and managed a first of its kind workshop for four days. In our laboratory we had this grand color projector that could be connected to the computer and exercises were projected on to a screen. When you gave a command to compute there were these dots coming up one by one on the screen. It would take so long that Lars would joke – now it's time for commercial break! With that early intervention the frequency distribution-based calculations gave way to a little bit better way of doing things. At the end of this we had twenty-four people (figure 4) who had learnt the basics of how to create files, wind data sets, run the program to create gridded wind resource data and when used to calculate AEP for specific turbine models, the program would produce reasonable results for an entire wind farm. Of course there were many limitations, but notwithstanding all that a beginning in the right direction had been made.



Figure 4. WAsP Training workshop in progress in NAL during 14-17th November 1996

At this time, I started thinking of how best to use so much of data collected from the National wind Monitoring program. I realized that the Indian Wind Atlas was not coming any time soon. Instead of depending on the top-down approach, satellite images, DTMs, creating mesoscale flow fields and so on, I thought it may be a good idea to use WAsP to calculate wind resource grid around each mast data point. Subsequently I would also collect electrical grid availability information, type of land use patterns and possibility of making a preliminary assessment from wind power point of view. The origins of the 10 km radius from the mast to turbine also can be traced to this. One must keep in mind that there was no Google Map in those good old days. I made this proposal to Ajit Gupta, who

was by then heading the wind program at MNES. He saw the merit in the idea immediately and got the project going for a hundred locations. Dr.Rangarajan who took over from Miss Anna Mani the mantle of running the IITM, FRU was tasked to front end the project management. Looking at the magnitude of the work and perhaps have more people working on such ideas the 'micro-survey' reports that were location specific was born. Hundreds of such reports were created by a number of consultants and early developers probably found them quite useful. Quite a few new wind farms did come up in the suggested areas and capacity. These reports were provided in Hard Copies to concerned State Nodal Agencies who were to share them with developers approaching them. Some indirect validation did come when I got to see the PLF achieved coming close to predicted numbers from Sankaneri region, I have felt vindicated. I would like to believe that this initiative did help in the initial stages as there was practically no information with prospective developers about a given area. There was no Chat.GPT to help along! Of course the developers did their own analysis and came to their own conclusions.

Testing & Certification

The great wind rush of early nineties lead to a lot of soul searching and it became evident after 1997 fiasco in Gujarat that we need to pay much attention to the wind turbine deployment strategy. The Europeans were just beginning to discuss standardization and back home we had people who would use the terms testing and certification interchangeably. The then MNES set up an expert committee under the leadership of Ajit Gupta to look at the testing and certification reports that came along with different models and it really was step that had far reaching impact that set the tone for future development in India. First few meetings were a little chaotic but quickly what needed to be looked at carefully emerged. The idea of publishing List of wind Turbine models by the ministry was mooted as a guide for the buyers of wind turbine giving an assurance of the fact that the turbine has been tested and certified by competent laboratories and certification bodies. There were multiple certification systems and it was complicated to deal with small details. Over a period of time the idea of harmonization emerged among the certification bodies. Notwithstanding this, there were two strong contenders. One was the GL Rules and the other was the IEC system of type certification. The purpose and end results being common, slowly a way of dealing with such certification systems emerged quite clearly. Slowly the CWET also developed its own certification system with help from Riso National Laboratory. This experience complemented the ability of the committees. Once CWET became functional the responsibility of revising the lists (quarterly) was transferred to them. The committee used to come under great pressure quite often. At one time one of the manufacturers brought a letter from one of the European certification agency that very shortly the type certificate would be issued and only some calculations were pending and recommended that it can be included in the RLM being issued. Then I asked the manufacturer to get the certification engineer on call. After listening to his points, I asked him why he cannot issue the Type Certificate pending his completing his work. Then he quoted his constraints about being bound by his own accreditation rules due to which he can never do that. I then asked him and our manufacturer how they expect us to bend the rules for inclusion? They did not like it, but they had to accept. Problem of the permitting authority is creation of precedence by making allowances. Such a system will fail sooner than later. This is neither appreciated nor respected. In next round, they got their TC and got into the list. I do think it is one of the most important reasons as to why we have fewer accidents on one hand and on the other it has kept the fly by night operators at bay for long enough. Perhaps on hind sight there will be some realization of the fact that it was and is indeed an important instrument that ensured that quality products got into the Indian soil.

Indian Wind Atlas

During my tenure at CWET the question of not having an Indian Wind Atlas came up several times and found echo even in the Parliament. By this time we had enough data from across over 500 monitoring stations and the technology of meso scale modelling had reached some maturity level. As it was a big ticket project, we had to get offers from various national and international agencies engaged in such work. Finally an expert committee set up for the purpose of evaluating various offers heard the proposals and accepted the offer from Riso National Laboratory and asked us to process the papers for awarding the contract. Accordingly the work was started and the project was awarded to them with CWET team actively participating in the project. At this time there was a sudden interest in pushing the project to an US based laboratory. This was not acceptable on two counts. The project was already awarded after following all rules and regulations and Riso National Laboratory, Denmark was a Government of Denmark entity and their offer was quite low compared to the offer from US. There was also a training element in the process such that future development could be undertaken indigenously. Besides that, there was no clear strategy to take things further towards creation of the Indian Wind Atlas under US based push. As such we had come under severe criticism for not being able to produce the atlas after decades. This took an ugly turn personally for me as the then Joint Secretary took it as an affront to his authority. However, the work continued as per plan and the Indian Wind Atlas was indeed released in 2008. I had by then left the services of Government but was happy that I was instrumental in getting this done.

Today when I see an Indian Wind Atlas at 150 m agl putting the potential at 1000+ GW, I can only smile at the completely changed viewpoint regarding the potential. The conservative 50 GW at 50 m agl has not been reached after 2 decades, but now we aim at 200 GW in one decade. I am sure it will happen as the mind set has changed so completely.