

Solid Resource Management in Kurudampalayam Panchayat, Tamil Nadu: A Classic Case that Transforms Waste into Resource

Centre for Rural Infrastructure (CRI)
National Institute of Rural Development & Panchayati Raj (NIRDPR)
Rajendranagar, Hyderabad – 500 030

Abstract

Like it is for the Municipalities and Corporations in Indian cities, managing solid waste in rural areas is becoming a daunting task for the Gram Panchayats as well. With the changing life style; consumerist and use-and-throw culture people in rural areas of India have started generating a lot of waste, which at the end of the day falls on the lap of Gram Panchayat (GP) administration to clean up. GPs that are close to the cities and towns are far more vulnerable to this hazardous culture, compared to the ones that are remotely located. Kurudampalayam Gram Panchayat that is close to Coimbatore city in Tamil Nadu not merely manages solid waste well; rather it recovers usable resources from waste. Therefore, Kurudampalayam GP forbids the usage: ‘solid waste management’, and replaces it with ‘solid resource management’. The Solid and Liquid Resource Management (SLRM) Unit at Kurudampalayam, as it is locally known, has a lot to offer to other Gram Panchayats desirous of drawing ideas for managing solid wastes from households, institutions (schools), restaurants, and marriage halls in rural areas, and how to convert them into resources that become reusable.

Abbreviations / Acronyms: DRDA: District Rural Development Agency; GP: Gram Panchayat; SLRM: Solid and Liquid Resource Management; SWM: Solid Waste Management

June 2016

Solid Resource Management in Kurudampalayam Panchayat, Tamil Nadu: A Classic Case that Transforms Waste into Resource

Introduction

Managing the domestic refuse (solid waste) generated by households in the Gram Panchayats that are located especially in the vicinity of towns and cities is increasingly becoming a matter of serious concern in India. A comparative glance of the type and amount of waste generated in Indian villages that are remotely located and villages that are close to cities and towns make us infer: that in the villages that are remote the type of waste generated is mostly biodegradable, and the amount of waste generated is manageable because of the biodegradable nature of waste generated; whereas from the villages that are close to cities and towns, people frequent to towns and cities and adopt a consumerist lifestyle, which results in generation of more wastes – and mostly waste of non-biodegradable nature including plastics, and carry bags. When it comes to solid waste management, villages that are close to cities and towns require being paid attention on a priority basis.

Profile of the Study Village

Kurudampalayam Gram Panchayat is located very close to Coimbatore city in Tamil Nadu. It has 14 wards, with a population of 33,000 that make into 11,360 households. There are marriage halls, restaurants, shops, schools and so on. The amount of daily waste generated is not less than 1000 kgs per day. The practice that existed before the introduction of solid resource management system in Kurudampalayam was ‘discarding domestic refuse in street corners, and in the open drains’.

The problem of wastes was raised for discussion at Kurudampalayam Gram Sabha meetings, often enough. But going by the enormity of the problem, and pushed by other developmental priorities the matter was never taken to the level of initiating a practical action. In 2012, the DRDA Coimbatore came forward to support Kurudampalayam,

when, they found it an opportune moment to initiate practical actions about managing solid waste in this Gram Panchayat. The GP took the help of technical experts at the Indian Green Services (IGS), Coimbatore and started it in a small way in a few wards in October 2013. All the elected ward members heard the idea with indifference. Not many found the idea of collecting and handling garbage attractive. The Panchayat President (*Sarpanch*), and one ward member got down seriously into it. After nearly three years now, Kurudampalayam Gram Panchayat SLRM is a model that receives visitors / development tourists almost daily.

There are 26 workers involved in solid resource management in Kurudampalayam – most of them are women. They have been formed into SHGs. Establishment of this Solid Waste Management (SWM) unit has taken more than five million Indian rupees as capital cost, which does not include the cost of the land. Funds have been raised from both government and private sources (CSR). Currently, the monthly operational expenses come to Rs.2.0 to 2.5 lakhs. Since the unit is involved in every minutia of solid waste management, there is also a one-year academic programme in SWM run by IGS, Coimbatore in the premises of Kurudampalayam SWM Unit. Out of the 14 wards in Kurudampalayam, as of March 2016, eight wards have been covered. The remaining 6 wards shall be taken up gradually, after the GP managed to procure some more vehicles (tri-wheelers) for waste collection.

Approach to Solid Waste Management

The basic approach to solid waste management in Kurudampalayam is that there is almost nothing that can be called ‘waste’. This is based on the premise *that any waste can be converted into resource that can provide utilitarian value as a useful product*. It might require changing the form through certain amount of processing, and presentation of the same, in a manner acceptable in the market. Any waste can be converted into a socially useful product. Hence, the usage ‘Solid Resource Management’ in Kurudampalayam and

not ‘Solid Waste Management’ as it is addressed in most other places. Precisely, it is not about solid waste management in the minimalist sense; rather it is about scientific management of solid waste in its entirety. Besides this, tertiary (third level) segregation is something unique at Kurudampalayam which is done with the idea of recovering every usable resource from the waste collected. The resource recovery chain is really long and tedious. The Unit is running since October 2013.

We shall analyze the definitional issues of *solid waste and solid resource* from environmental, economic and utilitarian standpoints later in this paper. As of now, we admit the expression, ‘solid resource management’ and move on to understand the approach adopted in Kurudampalayam covering the practical / operational sides of it.

The objectives of this study are:

- 1) To document the solid waste management model being followed by SWM Unit at Kurudampalayam Gram Panchayat, Coimbatore, Tamil Nadu
- 2) To draw lessons from Kurudampalayam experience for replication in other GPs in the state / country
- 3) To determine to what extent the resource recovery (‘solid resource management’) argument takes hold in practical terms at Kurudampalayam GP.

The steps the scientific management entails

STEP – 1: Community Education and Provision of Dustbins: At least two weeks before the commencement of the SWM Project (i.e. actual collection of waste from the door steps of households), ward-wise community education took place on types of wastes; and how community cooperation in waste-segregation at the household level can ease waste management at the GP level. The GP campaigned with the community to cooperate with the arrangement in their personal interests, and in the interest of

community well-being. Each household was provided with two dustbins – Green for dry waste; and Red for Wet Waste.

Box – 1: Uniform and Gears

The SHG women (genitors) have been provided with uniforms and gears, plus a whistle they blow to indicate to the housewives in the kitchen that the genitors are passing through their lanes, and that those who have to empty their dustbins must come out with segregated wastes.

Attached to the tri-wheelers are a first aid kit, drinking water bottle, and toolsets to take care of the preventive maintenance of the vehicle. The genitors carry their own drinking water bottles in the vehicle, so as not to feel hurt, just in case the households hesitate to offer drinking water to the genitors during the course of their work. It is possible housewives may hesitate to offer drinking water to the genitors because of the fact that they necessarily have to touch the water glass with the same hands they touched the garbage from all over. So, the Panchayat has made these arrangements for the genitors.

STEP – 2: Collection: Kurudampalayam engages 8 battery operated tri-wheelers (vehicles) for daily collection of waste from households and market area. The vehicles make two trips daily – one in the morning from 7.00 to 10.30 am; and again in the evening from 4.30 to 6.00 pm. The vehicle has two compartments – one for collection of ‘wet wastes’ and the other for ‘dry wastes’. Each vehicle has a driver (mostly a woman), and a genitor who empties the dustbins into the vehicle handed by residents at their door steps. The idea of collecting two times a day is part of their planning. It feels easy to touch ‘the wet waste’, when it is still fresh / or when it has not started decaying. It is a well-thought out plan, they have made it a point to collect wastes within 8 to10 hour interval. The unit attempts handling any type of waste of any quantity generated within the Panchayat.

Box – 2: Solar Operated Tri-wheelers

There are eight tri-wheelers used in door to door collection of solid waste. All of them are run by solar operated batteries. The SWM Unit has set up *serial solar recharging points* for these vehicles. When the vehicles come back after waste collection either in the morning or in the evening, they are left plugged in for charging the battery. They get ready for the next day's running. This required an initial investment, which the Panchayat could manage with the subsidies made available from MNRES, (GoI). These vehicles are addressed as non-polluting vehicles, and they do not require petrol or diesel to run. Use of solar power brings down the electricity bill, which the Unit otherwise, might have to incur.

STEP- 3: Segregation – Primary – Secondary - Tertiary: The households are supposed to segregate wet waste from dry waste at the household level, before handing them over to genitors. *This is primary segregation.* The genitors after collecting the waste from households, restaurants, marriage halls etc. bring them to the SWM unit and do secondary segregation. *Secondary segregation* is reported to be necessary because - all said and done – many a household do only a rough segregation into two different bins. The genitors do a secondary segregation and shift the wet waste fit for vermi-composting, and others go for tertiary segregation. Practically, *tertiary segregation* involves sorting dry wastes of different types – such as plastics, bottles, pet bottles, iron pieces, papers, card boards, cloth pieces, carry bags, tetra packs etc.

STEP – 4: Treatment: Wet wastes that are easily digestible / decomposable go into making vermi-compost; and wet waste of assorted nature go into plain composting covered with a plastic sheet. Like letters are sorted and posted to their destination boxes in a Post-Office, the non-biodegradable wastes are classified and kept separately for different recycling use. There are buyers for each type of waste – be it papers, card boards, bottles, pet bottles, bottle caps etc. Each type of bio-degradable waste has some

utility. Some of the items like orange peels, lemon peels, eggshells etc are processed by the SWM Unit itself and are converted into bio-products (See STEP – 7 below).

Box – 3: The paraphernalia & their uses

Cows: SWM Unit has 10 country cows. All fresh vegetable wastes / vegetable market refuse, and used plantain leaves from restaurants are fed to the cows. They convert such wastes into cow-dung within 6 – 8 hours, which otherwise shall take more than 45 days for composting. The cow-dung is used in the six biogas plants, which supply cooking gas to prepare food for the genitors, and students of SWM Programme conducted by IGS. The cow serves three purposes. One is that it reduces the amount of vegetable waste that must go into composting; secondly, it converts the vegetable wastes into cow-dung within 6 – 8 hours time; thirdly, the cow-dung it gives goes into producing biogas for cooking for the destitute women who are involved in solid waste management; and fourthly, the cow-urine is used for preparing '*panchacowya*' a solution used as organic fertilizer. The role of cow in waste management is thus explained by SLRM Unit, Coimbatore.

Ducks: There are about 20 ducks that move around in the composting yard. They are said to be eating up the insects that might come out of the garbage, and decomposing wet waste. They also lay eggs which are salable giving adding to the income the Unit makes.

STEP – 5: Store Keeping: Each type of dry waste is kept in one compartment each after segregation. There is a long tin-shed compartmentalized for this purpose. These items (bottles, pet bottles, papers, card boards, worn out cloths/footwear etc.) cannot be sold on a daily basis. So, they let them accumulate over a period of one or two months so that it becomes economical for recyclers who deal in such waste materials to buy and transport to their places. They are sold to recycling agents who visit this SWM Unit periodically.

Box – 4: Tools & Machinery

There is a cleaner machine, shredder machine, and sieve.

Cleaner: The cleaner is used for cleaning up the dusty plastics, bottle caps etc.

Shredder: The shredder is used for shredding the plastic waste into granules so that weighing it for sale becomes easy.

Sieve: There is a sieve used for sieving the (NARDEP) compost so that the quality of the compost is good.

STEP – 6: Sale as recyclables: These items (bottles, pet bottles, papers, card boards, worn out cloths/footwear etc.) are sold to traders who deal in recyclable waste materials. They go for reprocessing, and they may arrive in the market in several different forms.

STEP – 7: Sale after recycled products: Some of the wastes such as orange peels, lemon peels, egg shells are processed by the SLWM Unit. They become salable commodities. For instance, orange peels / lemon peels are dried up and powdered to be added in making scouring powders used for vessel cleaning. Similarly, egg shells are powdered and sold for use as organic fertilizers in rose gardens. They are presented as ‘resource recovery from wastes’ below.

Resource Recovery from Wastes

We broadly classify waste into Wet Waste and Dry Waste. The following table lists out the type of wastes and what (products) they are made into.

Sl.	Type of Waste	What they are made into (Products)
1.	Wet waste	Vermi-cast, Vermi-compost, vermi-wash, Organic compost
2.	Cow dung	Biogas, Scouring powder,
3.	Orange peels & lemon peels from juice stalls	To scent the scouring powder
4.	Egg shells	Egg shell powder used in rose gardens
5.	Cow urine	<i>Panchacavya</i> used as fertilizer, <i>Poochiviratti</i> (pest repellent)

6.	Coconut shells	Sold as such
7.	Chickens	Sold as such
8.	<u>Dry wastes</u> Bottles / glass Pet bottles Plastics of different types Iron pieces Papers / magazines / old books Cards / cardboards Aluminum tins / spray bottles / caps Milk cover / Oil cover Plastic covers of above 40 microns	Recyclables sold to recycling agents

These are the products made from wastes. Those that are recyclable are sold to traders who deal in waste materials. These two sources of income (viz. sale of products and sale of recyclables) contribute to meet 20% of the operational expenses of SWM in Kurudampalayam GP.

Box – 5: Employment Generation

Kurudampalayam SWM Unit employs 26 persons. Some of them are supervisors and most of them are women genitors formed into SHGs. They are from villages in the vicinity, who have no one to support them economically. More than 10 – 12 of them stay in the Unit itself because they have no house of their own. This helps them to take care of the cows, ducks, and chicken, collect the eggs that the ducks and chicken lay, and involve in maintenance of biogas unit etc. Some of these women are involved only in cooking at the kitchen. There is continuous cooking going on for these workers, and the students of SWM Programme. They do not have to worry about cooking food for themselves.

Cost of Setting Up the Unit

The Kurudampalayam Panchayat SWM Unit has been set up, reportedly, with an investment of nearly fifty million. This includes the construction of segregation sheds, purchase of tri-cycles, solar ports for charging the solar batteries etc. The funds required

for the capital cost has been partly collected as donation from friends and well-wishers of the Panchayat President, and partly as grant from the SSS scheme of the State Government of Tamil Nadu. The Project Officer DRDA has been very supportive. The District Collector, after a visit, has offered additional funds from the Collector's Discretionary fund. The unit has been set up in a rented land. Therefore, minus the land everything else has been mobilized this way. The infrastructure include: Many long tin-sheds with compartments, one covered area spacious enough to empty the loads from tri-wheelers and do secondary segregation, one office room, one sales depot, cleaning machine, shredding machine, 8 battery operated tri-wheelers, uniform and gears, solar power generation ports for recharging the battery operated tri-wheelers.

Operational Expenses of the Unit

The monthly operational expense of the Unit is reported to Rs.2.0 lakh to 2.5 lakh. The following table gives the operational expenses, and the sources of monthly income as provided by statements given by the GP.

Items of (recurring) Expenditure	Sources of Income
Salary of supervisors and genitors	User fees collection from households
Production expenses of organic products	User fees collection from shops / market
Cattle maintenance	User fees collection from Marriage halls
Vehicle maintenance	Sale proceeds of organic products
Rent for land	Sale proceeds of recyclable items (to scrap dealers)
Electricity bill	Visitor charges
Fuel & Transport	Bio-gas production from cow dung
Stationery	CSR Contribution
Medical check-up expenses (for the genitors)	
Contingents	

How does the Income and Expenditure work out?

An analysis of financial statements produced by the SLWM Unit of Kurudampalayam reveal that the items of expenditure far exceed the income from the operation. The sale proceeds of recyclables and bio-products covers about 20% of the expenditure incurred in

running the Unit. The user fees collected from residents, shops, and marriage halls contribute 60% and other income such as visitor charges, and CSR contributions help meet out the remaining 20%. The Unit was initially incurring heavy loss month after month for various reasons. There was no proper accounting system followed either. In the past one year (July 2015 onwards) proper accounts are being maintained.

Sustainability Plan

Financial sustainability plan is not in place yet. There are also ideas being worked out like the SHG women receive orders for food supply. The profit earned out of the food sale can be used to make up the loss incurred in running the SWM Unit. They are also hopeful to make the sale of products from waste, and sale of recyclables to fetch upto 30 – 40 per cent of the expenditure in the days to come.

Analysis and Discussion

We mentioned earlier, that the SWM Unit at Kurudampalayam attempts handling any type of waste in any quantity within the Panchayat. It seems to communicate that generate any amount of waste we are here to take them from you for treatment and recovery. In other words, *‘the more the waste generated, the more is the resource recovery for the Unit’*. The concept of Refuse and Reduce are not given importance. Any GP wanting to implement SWM should, first of all, promote the idea of ‘waste reduction’.

Is it ‘solid waste’ or ‘solid resource’ is an argument that still stands. For some ‘waste’ is a constructed-image and so ‘waste’ is a forbidden word. Viewing waste as a resource is, in fact, a healthy stance. We can certainly appreciate the spirit behind such a thought. But, in what sense one calls ‘waste a resource’ needs to be clarified. Is it practically possible to put forth a brilliant resource recovery argument, sticking to the bare facts of the matter. One viewpoint could be from the *environmental economics*, and the other standpoint could be from *monetary value*.

Waste as a resource makes an economic sense, only if we can recover a considerable amount of operational expenses incurred in converting waste into wealth / cash. Such an income can partly help sustain the operations, assuming it is partly supported by the user fees, and incentives from the state government through Performance Grant etc. The gross recovery made by converting ‘waste into resource’ is hardly 20% [of the expenditure incurred for SWM]. This does not include the expenditure incurred for converting the waste into usable products. But the amount of efforts put in to run and sustain the unit is unbelievably enormous. *The ‘waste into wealth’ argument holds good only from the stand point of ‘environmental sustainability’. It makes little sense as a ‘financial sustainability’ argument.*

Another dimension to this issue is, it often happens, in solid waste management projects, there is very high attention paid on the technology side of it – i.e. especially on how to treat each type of waste, and what products you make etc. This is perhaps because, most often, we tend to lay exaggerated emphasize on technologies, and insufficiently on building up a local management system to manage and sustain the task. We elaborate on vermi-compost, vermi-wash, NARDEP compost, bio-gas, use of bio-gas slurry, duck rearing, chick rearing, fish rearing and so on, while paying very little attention on building up a local management system to sustain. Very few of the GPs seem to have thought about meeting the operational expenses (month after month) involved in running the unit, until when they got their fingers burnt – unable to meet the operational expenses. In our attempt to recover resource from waste, one should not lose sight of the purpose. The purpose is clean village, and not making products from wastes. Making products and marketing is not a comfortable forte for any GP. The best and the simplest is to go for windrow composting of the wet waste, and sell the recyclable waste to the local scrap dealers.

The point is we should not mystify the technology side, brushing aside and ignoring the local management system that requires to be built. Solid waste management is not merely about employing certain technologies for treatment of waste – biodegradable – non-biodegradable and so on. The success hinges on establishing at the GP level a local management system

from logistics to cash inflow to final disposal. It requires massive efforts in aspects like educating the community; training the janitors who go door to door collecting garbage; meeting the operational expenses; user fees collection system and so on.

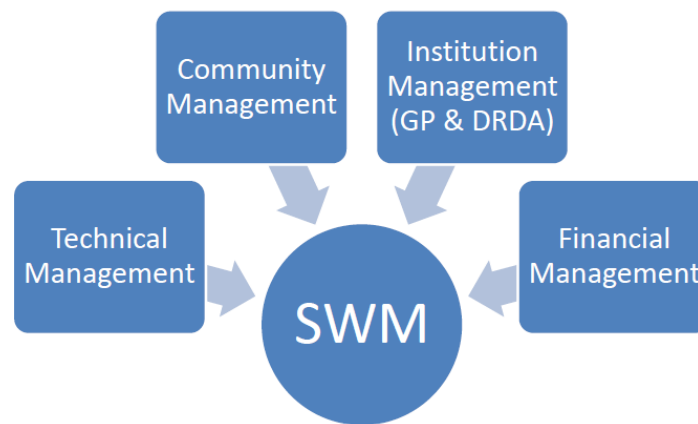
We must do away with the unnecessary (and often scary!) technological frills that complicate SWM at village level. It could be handled with no much complexity, if our plans are simple scientific disposal of solid waste. On the pretext of converting waste into resource we are imposing heavy financial burden on the Panchayats. This scares away some Panchayat Presidents from giving it a try at all. This is not to oversimplify the SWM nor to overemphasize the economics of it underplaying the clean environmental benefits. This is about practicability or sustainability of the idea in rural areas, where Panchayats have very few sources of income to manage provision of drinking water and environmental sanitation related services.

This analysis comes from one of the best run Solid ‘Resource’ Management Unit in Tamil Nadu namely Kurudampalayam GP, where the amount of resource recovery made is 20% of the operational cost, which this does not include the interest for the capital expenditure made. There is just one argument we can buy from ‘waste into resource’ argument. That is *the more you convert waste into usable commodities, and recyclable items etc. the less you demand from the fresh resources of the earth*. A student of Environmental Economics may admire this idea, but no Panchayat President who is supposed to practically manage the day to day affairs of a Gram Panchayat shall be willing to pay heed – especially if one gave a thought about long-term sustainability of solid waste management activities. User fees must be collected from residents, shops and other establishments. There must be some financial support from the state government to meet the operational expenses, like it is done in the case of primary health care expenses. Otherwise, Kurudampalayam model is a bank of SWM ideas to draw and customize / contextualize to one’s requirements, and not for complete replication.

The Management Model

The management model adopted by Kurudampalayam GP can be presented as presented in Figure – 1. But when it comes to verbally presenting Kurudampalayam model to a visitor, the technical management aspects overshadow everything else. It has elements like community management, institution management, and financial management. Technology is just one of the elements that SWM entails, important though.

Figure – 1 Solid Waste Management (SWM) entails



Some Daunting Questions

- **Replication Possibility:** As you study the system and the works being carried out, one tends to think that Kurudampalayam is a place to admire and feel amazed about. It requires a lot of efforts to replicate. All said and done, replicating a model is no wise idea. We must draw ideas from Kurudampalayam, and appropriate it suitably to one's own village.
- **Financial Sustainability:** The financial sustainability, meaning '100 per cent self-financing the operations' is yet to become a reality. About 20 – 25 per cent of the operational expenses are covered by other sources of finance such as the funds meant for development purposes or through CSR support.

- **Rich litter and the poor clean up:** The community lethargy makes secondary segregation unavoidable. Dealing with dry wastes (such as plastics, bottles, pet bottles, iron pieces etc.) is a bearable task. However, dealing with wet waste (kitchen refuse, vegetable and fish market refuse etc.) is truly indignity, necessitated by poverty for the poor people to be involved in, in order to make a living. This is a disgrace rendered by poverty. This process requires serious thinking over. There must be technology solutions found to reduce the number of people involved in dealing with wet waste. Community sensitivity requires enhancing for proper segregation at the household level so that wet waste can straight away go to the composting yard without having to be touched again. The principle of ‘my waste my responsibility’ should be inculcated amongst the residents. Otherwise, it’s like let the rich litter and the poor clean up.
- **Keep Stretching on and on:** The SWM Unit at Kurudampalayam keeps stretching its works – with cows, cow-dung, cow-urine, ducks, poultry, fishery, manufacturing and sale of products including eggs from chicks and ducks, use of biogas, sale of cooked food and so on. The work chain keeps expanding endlessly in the fond wish of making the Unit financially self-sustaining. This might look daunting or be scary for any *Panchayat Sarpanch* who visits this place with the idea of borrowing this model for their place. Environmental sanitation or solid waste management is one of the essential items of work, a Panchayat is supposed to take up. Kurudampalayam SWM gives an impression that it is too much work for a Gram Panchayat to put in so much effort on SWM, given the other responsibilities of Gram Panchayats. However, certainly, drawing ideas from the possibilities shown here, one can tailor-make to one’s requirements.

Conclusion

Kurudampalayam SLRM Unit is a must visit for anyone who wants to learn how waste collection can be organized at GP level, and how wastes are made into usable products. But, given the physical work and organizing that go into the chain of resource recovery process adopted in Kurudampalayam, it is scary for anyone when it comes to the question of replication. But as mentioned earlier, one can draw ideas, and customize. And in fact, that is the right approach when it comes to replicating rural development models. But at the same time, one should not get into sludge in the name of SWM or stretching things too far.

The ‘resource recovery argument’ does not hold good making an economic sense. However, it makes an excellent environmental / earth saving idea, one needs to give serious consideration about. The caution is one should not misread or wrongly get guided that the sale proceeds of the products made from wastes, and the recyclables are going to meet the expenditure incurred by an SWM Unit in any considerable proportion. If done meticulously, it might help meet at the maximum one-fifth of the total expenditure. User charges collected from various waste generators in any given village such as households, vegetable markets, restaurants and tea stalls should be able to meet the remaining four fifth of the expenditure.

While we state this, we must make a mention that there should be no expectation in terms of return on the investment (or payback period) for the capital cost invested on items such as the land, waste collection vehicles, the segregation shed, shredder machine etc.

Kurudampalayam SWM Unit has several ideas to offer to any GP that is desirous of learning how to manage waste at GP level. It also has all the potentials to emerge even as Training cum Demonstration Centre for Solid Waste Management in Tamil Nadu. Yet, as a model for replication at village level, Kurudampalayam is over-involved and is

stretching things too far. A Gram Panchayat cannot get stuck in a mired-plan of solid waste management, when the duties and responsibilities of a GP are many more.

Acknowledgements

The authors gratefully acknowledge the cooperation extended by Shri Tha. Murugan, Project Director, DRDA, Coimbatore, Mr D Ravi Panchayat President, Kurudampalayam and Mr Gopi, Unit in-charge at SWM Unit in Kurudampalayam for the excellent support they offered during our field visit to Kurudampalayam. We learnt a great deal about solid waste management during this visit, and it has helped us write this case for wider audience.

Authors

R Ramesh PhD
Assistant Professor
Centre for Rural Infrastructure (CRI)
National Institute of Rural Development & Panchayati Raj (NIRDPR)
rramesh.nird@gov.in

&

P SivaRam PhD
Professor & Head
Centre for Rural Infrastructure (CRI)
National Institute of Rural Development & Panchayati Raj (NIRDPR)
Hyderabad – 500 030
polankis@gmail.com