Interventions in location specific technologies and material utilization through Women Technology Park in India

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Abstract: For any developing country, rural infrastructure development and expanding farming and the non-farming economy will be the major area to look forward to inclusive growth. To eradicate poverty and to have holistic growth primary approach should be towards developing employment potential, creation of enterprises and livelihood enhancement in rural people through region-specific technologies using indigenously available resources. The establishment of Women Technology Park (WTP) proposed in this research work will lay emphasis on promoting appropriate technological inputs that may improve productivity. Also, the quality of farm and non-farm sectors will be enhanced with supreme livelihood options in tandem with skill enhancement and capacity building. They also promote developing management skills coupled with the entrepreneurial mindset and will enable them to introduce new and innovative technologies. This kind of parks will promote usage of indigenous resources with increased energy and ecosystem management. Hence, it is envisaged that this kind of establishments, if done such as “Technology parks” will help to create a concrete and also tangible socio-economic benefits to the rural society by provision of newer technological solutions, alternate training method implementation which will end up in unique skill development and also will increase the support rendered for their implementation. In this research work, authors considered four different location-specific techniques for interventions including weaving technology, metal art skill development, banana fiber extracting and usage, habitat and construction technology development. Through the establishment of WTP, these technologies were tested first, and the rural women were trained to sustain via usage of those technologies for their livelihood.

1. Introduction
Many countries in the world are termed as developing countries or less developed countries or less economically developed countries according to several indicators such as lesser developed industries, and lower Human Development Index (HDI) etc. A developing nation faces several issues and challenges such as sanitation, pollution, industrial growth stagnation, hazard related issues, poverty, resource management etc., which were being addressed in both national and international levels through several developmental measures. Measures being taken by world leaders to transform the planet by 2030 with the adoption of new UN goals that may eradicate poverty, improves health conditions and education. The newer agenda brought will supersede Millennium development goals (MDG) that expired during 2015 with a newer and ambitious scope. A new set of goals focus on improving lives and livelihoods, increases food and water security, provide clean and sustainable energy with good health and productive ecosystem through properly planned and well executed governance. As rightly said by Dr. Stafford Smith, “Ultimately, the choice of goals is a political decision. But science can inform what combination of goals can achieve a sustainable future. And
science can identify measurable targets and indicators,” newer Sustainable Developmental Goals (SDGs) implemented during 2015 replacing the Millennium Development Goals (MDGs) that focus only on well-being improvement for the developing countries [1].

Sustainable Development Goals (SDG) derived by the United Nations has 17 goals, 169 targets, and 232 indicators to monitor and track progress. Also, it is found that many countries may be losing sight of the synergies that exist and the effective tradeoffs between goals and targets, which is acknowledged by many from its initiation [2]. Research works being undertaken to address this issue to develop and identify these synergies and tradeoffs. It is found that most of the tradeoffs to be address at the national level. Primarily SDG focus on equity, Goal 5 explicitly aims in empowering women and girls, which can be tracked by several indicators which are further developed [3]. Women empowerment and economic development are very closely knit in one direction; also, it can play a major role in driving down an inequality that exists between male and female in developing nations [4]. Viewing critically, human rights in both theoretical and with evidence suggesting that greater investment to be done in women’s health which could be the “best buys” for greater economic development and social wellbeing by eradicating poverty [5]. Several studies focused on evaluating dimensions of poverty which may end up creating a better world which is free from poverty by providing a framework analysis of all root causes. In SDG 8, which promotes removing poverty and hunger, the focus is given to provide equal access for women to access basic transport/infrastructure that will lead to greater economic activities. Also, it implies investing in women’s health and nutritional status by providing them with a chance to work, which will increase productivity. Thus, it is very evident that achieving SDG 5 will ultimately lead to poverty reduction (SDG1) [6, 7]. Hence it is very evident that research works focusing on women empowerment, poverty eradication and sustainable development in developing countries are need of the hour [8, 9, 10, 11].

Keeping this in view, this research is designed and executed on improving the living conditions, reduce drudgery, and provide income generation opportunities to women through skill development to achieve a better quality of life. A variety of technological interventions were attempted in the identified sectors. Through this endeavour, several technologies are made available to optimize the production processes based on natural and human resources. The primary aim of this work is to generate awareness about newer technologies, tools and appliances that are women-friendly, help them in the day-to-day operation and also give to provide them exposure about effectively utilizing natural resources and technological solutions for the problems faced by women through networking.

2. Need of Women Technology Park
As per provisional reports of Census India 2011, women constitute 49.30% of the total population in Warangal district, but are often not able to reap adequate benefits of progress due to lack of empowerment. Women are involved in almost all the livelihood activities of Warangal district including the traditional ones like weaving, brass metal works etc. Warangal district with more than 20,000 Self-Help groups (SHG’s) is one of the districts which has been making rapid strides in SHG movement. These SHG’s are fast emerging as instruments of socio-economic changes in rural areas.

It is hence very evident that there is a dire need for affordable and appropriate technologies blended with modern tools and techniques, yet there are no intervention mechanisms put in practice anywhere for fair usage. Hence there arise a need and demand to produce a mechanism or framework to pool available better technologies and offer them to various users. Keeping this point in mind setting up a Rural Women Technology Park (RWTP) is arrived by the authors to serve as a bridge between various users and developers, identification of proper technology needed focusing on improved productivity, employment and to enhance the livelihood of rural women. Setting up of the RWTP is taken forward, which not only served in the development of technology but also various people in developing their skill level to get more and better employment.

3. Scope of Women Technology Park for banana fiber processing
In the study area, women have very limited scope to get exposed to newer and recent developments and technologies due to improper dissemination of information via all sources. The WTP will act play as a key stakeholder and supporter to make them exposed to better technologies that can help them to
generate more income through increased productivity, targeting a better and improved livelihood. Since women in the study area lag awareness on modern tools and technologies, a WTP is initiated to provide exposure and to provide economic stimulus through proper training focussing on enhancing their economic status through increased productivity.

Hub and Spoke structure of Women Technology Park is the model befit for the district (Figure 1). Satellite (Cluster) units for the identified location-specific interventions are at Bacchannapet village (Weaving), Pembarthi village (Copper and Brass Crafts) and Atmakur (Banana Fiber Unit). The Women Technology Park (Main Hub) was established at Hasanparthy village, Hasanparthy Mandal where a CFC, Training Centers, Agro and Forest Produce Processing Units will be established along with provision for capacity building on Construction and Habitat Technologies. The location of the proposed Women Technology Park is shown in Figure 2.

Primary emphasis will be focusing on enhanced living conditions with reduced drudgery and also to provide standard income-based upon skill development and training the population in the health, nutrition so that they can have a better lifestyle and quality of life. Technology parks, specifically focus on providing necessary tools and services to enhance living conditions, reduce drudgery and increase revenue through skill development in order to provide them with a better lifestyle.

A variety of technological interventions will be attempted in the identified sectors. With the experience gained so far and local presence, the institution through its expertise manpower and multifaceted talent can provide sustainable development through an integrated and multi-sector approach. Through this endeavour, a number of technologies will be made available to optimize the production processes based on natural and human resources. The primary objective of the WTP is to promote awareness about latest technologies, tools and appliances that are women-friendly that may help them to perform better and also to train them in effective utilisation of natural resources, technological solutions for the problems women face through networking [12, 13, 14, 15].

Figure 1. Hub and Spoke structure of Women Technology Park
4. Methodology
The generic methodology followed for all the technologies is shown in the Figure 3 below.

The methodology leverages

- **Technology**
  - Identify appropriate opportunities and technologies
  - Adopt and/or develop implementable technologies

- **Network**
  - Connecting the women through SHG, NGOs and artisan societies
  - Forming women teams
  - Connecting with mentors

- **Train**
  - Training at the villages accounting for resource availability
  - Focus is on the skill development

- **Workspace**
  - Provide workspace at SREC
  - Connect to other workspaces around Warangal area close to their home

- **Market**
  - Providing sales outlet for the products
  - Creating a brand

**Figure 2.** Map of Warangal District showing Location of Women Technology Park
(The picture represents both urban and rural districts of Warangal before division)

**Figure 3.** Methodology followed for all technologies considered by WTP
1. **Cluster based approach** using the Hub and Spoke structure and adopts Provision of Urban Amenities to Rural Areas (PURA) strategy, a concept spearheaded by the former Indian President Dr. Abdul Kalam.

2. **In-line with availability of resources (labor and material)** - WTP designed the programs keeping these seasonal availabilities of resources in mind for both raw material (banana fiber) and training programs.

3. **Technology interventions to improve the value created** - The general interventions planned by increasing motivation, providing enabling technologies, and training.

4. **Financial Empowerment** – by enhancing their financial literacy, connecting to resources, and providing access to markets.

WTP platform will be used to showcase multiple rural-based technologies focusing on dissemination and demonstration, including an option to adopt for the benefit of a larger women group. Proposed WTP will target to introduce newer avenues with appropriate technological inputs which may end up in increased productivity, quality of several farming and non-farming sectors, propose non approached avenues in skill development and will build capacity, also support with new livelihood options. Also, it promotes better usage of the indigenous resources coupled with good energy and ecosystem management, develops management and entrepreneurial skillset and also will introduce new and innovative technologies for the rural sector.

Authors genuinely envisage that the establishment of “Technology parks” will create a sustainable and responsible employment generation ecosystem with properly established and tangible socio-economic benefits targeting the rural community. It will provide them with the chance to learn newer technological solutions globally available customized to their domain and area, provide capacity and skill development training and also will support the process implementation at their home or office. Also, authors, after setting up this WTP and implementing the whole process felt that the design methodology and technological interventions are highly profitable even though some are intrinsic.

The target of this research is to create a WTP in the study area to promote technologies that are not available for common women and to benefit the larger group by emphasizing on enhanced productivity.

WTP created a focus on enhancing productivity and quality, aiming to introduce new livelihood options for farming and non-farming sectors. This also targets to enhance skill level and capacity building coupled with optimal usage of locally available resources with good energy and ecosystem management. There is additional benefit attempted, including developing the managerial and entrepreneurial skillset and also to introduce innovative modern technologies.

4.1 **Weaving and Handloom Technologies**

The interventions in waving and handloom technologies were induced to identified families in and around Bachannapet village of Warangal district. Through this WTP few decentralized programmes were conducted for handloom weavers focusing on bringing about skill upgrading for skilled labour and semi-skilled handloom weavers, this enhanced their productivity, made them earn more and shown newer markets to their products. Proposed technological interventions were inculcated to identified families in and around Bacchannapet village of Warangal district through a decentralized training programme for handloom weavers targeting skill upgradation amongst skilled and semi-skilled weavers.

Figures 4 shows training programmes conducted women on weaving using power looms and weft machine. Training programmes were also conducted to women on Tie and Dye techniques and Block printing, as shown in Figure 5 and 6. The specific interventions considered were as follows:

- Transferring good technology concerned with designing, weaving, and processing to the weavers.
- Motivating the weavers to adapt better and adaptable technologies.
• Improving level of weaver motivation to adopt better technological solutions
• To train dyers, weavers and designers who are associated with handloom cooperative societies and help them to achieve better production with good quality so that they can earn more and access better markets.
• Ensuring yarn availability with requisite counts always.
• Introduction of looms with attachments like dobbies and jacquard for training as well as for weaving by the weavers.

Figure 4. Training on Power looms and Weft machine

Figure 5. Training on Tie & Dye technique to women

Figure 6. Training on Block Printing
4.2 Metal Art Ware Technologies

Although the metal crafts have a huge potential both in domestic as well as in the international markets, yet no significant work has been done to promote the same. Serious attention is needed on technology development, development of proper tools and machines, quality testing measures, design development and packaging etc., in this sector with the expertise of the mechanical engineering department of the institute. An effective institutional mechanism was set up for the following:

- Technology Development
- Design Development
- Marketing Assistance
- Social Support, Awareness Generation
- Product diversification and documentation
- access to government societies for selling
- Marketing awareness and access to financial sources

4.3 Banana Fiber Extraction

Banana is grown over an area of 1837 Ha in Athmakur, Parkal, Shayampet, Chityal, Parvatagiri, Geesugonda and Mogullapallimandals (blocks) of Warangal district. Production in 2011-02 was above 55000 MT. Department of Horticulture is popularizing cultivation of Banana by tissue culture instead of suckers. The district had large tracts of drylands / rainfed areas / wastelands which can be utilized for promotion of banana horticulture [17]. Hence the proposed intervention envisages setting up of a facility for Banana fiber extraction units exclusively for women. Presently, waste banana stems pose a problem of disposal and are available almost free of cost. The processes involve the collection of banana stems from fields, cleaning, grading, and converting it up to finished readymade garment. The banana fibre is being used for weaving attractive pieces of clothes, rugs, sarees etc. Besides, it is also being used to produce a variety of items such as hats, photo frames, trinket boxes, gift bags, picture frames, handbags, belts, baskets and sandals etc. Dresses woven out of natural fibres are in great demand inside and outside India. The banana fibre can also be utilized to reinforce soil to improve geotechnical properties [18].

Banana is a seasonal plant which is grown over a large area (1837 Ha) in study area among various blocks with a production exceeding 55000MT. The whole process is popularized by Department of Horticulture, Telangana. Also, it is valid to note that the district has a huge quantum of unutilized lands for banana promotion, which makes the proposed intervention mandatory to setup banana fiber extraction plants. Waste banana stems pose a huge disposal problem, through this intervention can be effectively utilized for fiber protection (Reduce-Recycle-Reuse concept) and then can be used for material production.

Methodology: The extraction of natural fiber from the plant required certain care to avoid damage. The department of mechanical engineering, SR Engineering College has done some experiments wherein the plant sections of banana plant is tethered from the stem and rolled so that moisture is removed. Next step is to perform manual removal using a comb to remove any pigments, broken fibers or cellulose coating if any. The fibers obtained were then washed, cleaned and dried in natural sunlight. Yet, it is found that mechanical and manual extraction of banana fiber is cumbersome and may cause damage to the fiber. Hence this is not recommended for industrial applications and for production purpose. Having this in mind, a custom-made machine is designed and developed to extract banana fiber automatically. The manufactured machine consists of two beams horizontally placed with a carriage attached with a specially designed combing mechanism that can reciprocally move.

Fiber extraction using this machine can be easily done by keeping the cleaned banana stem in the platform provided and clamping the ends by jaws available. This avoids relative stem movement and eliminates premature stem breaking and fiber breaking. Produced fibers were then cleaned, dried in an airtight chamber at 20°C for three hours and labelled for the lamination process. Once the fiber is produced, generic weaving process is adopted like other textile fibers. The process of extracting banana fibre is shown in Figure 7 below.
Figure 7. Process of extracting fibre from banana stems for making fabric and artifacts

**Product Application:** Banana fiber is always a multi-celled structure with large lumens that are in relation with wall thickness. It is also evident that the cross markings in this fiber are very rare. Tips of the fiber are well pointed and flat with ribbon-like individual fiber, diameter varying from 14 to 50 microns. The length of fiber varies from 0.25 cm to 1.3 cm generally, which shows large oval to round lumen. It is a natural fiber with very high strength that can also be blended quite easily with even cotton fiber or any other man-made fibre for producing blended fabric. Banana fiber also exhibited high tensile strength and used widely in all cotton industries in many places. It also finds usage in high-security currency paper and other paper production, cloth packing industry for agriculture produce, towing ropes for ships, drilling cables etc. Figures 8 and 9 represent various training programs organized for women on banana fibre extraction and making artifacts.

Figure 8. Training programmes on extracting banana fibre
Figure 9. Training programme on Plaiting, roping and making decorative articles using banana fibre

*Intervention:* It is observed that banana fibre is a natural fibre that can be blended easily with cotton fiber to generate blended fabric and textile material that has high strength. Authors designed and developed a Semi-Automated Pirn Winding Machine shown in Figure 10 below to continuously wind the fiber on multiple pirns while the user is attaching the fibers. The machine reduces the stress on the user and improves the efficiency (quantity of fiber produced in each time and can be used directly on the power loom). The machine is easy to operate, modular, portable, and inexpensive. Thus, the machine can be acquired by the women entrepreneurs in creating banana fabric.

Figure 10. Semi-Automated Pirn Winding Machine

4.4 Construction and Habitat Technologies
The availability of rich mineral resources like laterite, dolomite, coal, clay, black granite and limestone other than sand and huge deposits of granite and iron ore in the district offers scope for establishing capacity building activities for women workers in construction and habitat sectors. Some of the mineral-based industries available include fly ash brick units, concrete production, blocks and brick manufacturing units, mosaic tiles manufacturing which can be promoted in the district. In the housing segment, the greatest benefits for development accrue from homes built by the informal sector. Such homes tend to be built by small firms using indigenous techniques and a large pool of semi and unskilled labour. Investment of a given amount in informal housing tends to generate approximately one to five more jobs than formal housing. Additionally, it provides six times as many dwelling units - although of poorer quality. The reuse and recycle concepts, machines built with simple mechanisms in
the construction field improve productivity economically and timely completion of the projects [19, 20, 21, 22].

Furthermore, labour-based construction technologies and local materials used by local contractors maximize the local economic benefits. Some of the challenges generally faced by the local masons/artisans are:
- Lack of technological know-how
- Unavailability of the raw materials
- Unsuitability of local stabilizers; access to the market
- The institutional frameworks to utilize and promote the technology

Figure 11 below illustrates the methodology and work plan implemented by WTP to train the women.

![Figure 11. The methodology and work plan to train the women in construction and habitat technologies](image)

In addition to empowering women who are in the social sector by providing them necessary training and education required in the building construction field, they will also be involved in the following activities for the sustainability of the programme.

- Developing and promoting budget friendly technologies through intervention concerned with shelter sector
- Performing active research in developing appropriate technologies and newer materials.
- Development of alternate and newer building materials
- Addressing the concerns related to environment of habitat development
- Enhancing local economy through development of indigenous materials and skills.
- Improving work life quality of workers through intervention.
- Promoting workers collectives to improve their quality of life.
- Exercising capacity building through extensive training programmes for workers and professionals.
- Partner networking to increase collaboration.
- Dissemination of information about solutions available for cost effective shelters.
- Policy development and implementation support focusing on economically weaker sections, slum dwelling people, tribal population and for other fringe community.
- Development and building barrier free disabled friendly building for society.

Figure 12 below shows training programmes conducted for women on making cement bricks and fencing poles.

![Figure12](image)

5. Science & Technology Component
Established WTP pioneered in several technologies and made them available to rural women entrepreneurs. The science and technology components include

- identifying appropriate needs (like making fencing materials) and technologies (molds, weaving technologies)
- adopting these technologies to local conditions (women-friendly, environmentally sustainable), and
- training the women entrepreneurs to leverage these resources.

In the identification of appropriate needs and technologies, we found opportunities suitable for local conditions that can be solved by appropriate cost-effective technologies and developed unique technologies to address those needs. For instance, WTP identified a need for tamarind powder for treating diabetes and developed drying techniques. While the technologies developed through this research are readily available for mass production or industrial scale use, WTP is acting as a catalyst in developing and disseminating these technologies. Through this WTP, many women in the study area obtained benefits through technologies developed and materials available for their usage.

WTP also helped in creating financial and marketing awareness for commercializing these technologies for women. It is also providing training so that women can understand and apply technology without formal education. Thus, WTP aims to provide a bridge or platform that acts between the users and the technology developers and focus on finding appropriately usable technologies that may improve productivity with increased production and also target increased employment with an enhanced livelihood. Also, researchers are confident that this method can be replicated anywhere for any product/process through the framework developed as an outcome of this research.
6. Follow Up Action (Post Project)
WTP will continue to promote rural women entrepreneurship in the study area by creating a collaborative partnership with Nest for Entrepreneurship in Science & Technology (NEST – a college-level center for entrepreneurship), Collaboratory for Social Innovation (CSI – community outreach cell of the college), and SRIX (a technology business incubator housed in the college). CSI is engaging students to make them socially aware, developing new technologies, and spearheading innovative practices. NEST helps in creating new market initiatives and make student teams available for rural women entrepreneur to commercialize and reap the benefits. SRIX encourages and mentor women to scale-up to small & medium enterprises and connect the entrepreneurs to industries and other organizations. WTP runs training programs, serving as a resource center for addressing problems and needs of women, and one-stop consulting services office. It will also help in acquiring quality raw material at a reasonable cost, provide equipment for the processing (weaving & construction technologies), and marketing aggregator and seller. A small percentage of profits generated will be used for the sustainability of the center.

Researchers obtained several intuitive factors influencing women empowerment through this research work through the help of NEST, SRIX and other stakeholders involved in this project. Indeed, it is very pertinent to say that this kind of WTP establishment support not only active research but also offer societal support. As an outcome of the work this WTP runs training programs, serving as a resource center for addressing problems and needs of women, and one-stop consulting services office. It will also help in acquiring quality raw material at a reasonable cost, provide equipment for processing (weaving & construction technologies), and marketing aggregator and seller. A small percentage of profits generated will be used for the sustainability of the center.

7. Conclusions
For a nation’s development entrepreneurs are key, any nation with a greater number of them is sustainable in the volatile economic scenario existing these days. Considering this need and demand, many countries are working towards empowering their society, and a paradigm shift is being achieved these days in several countries. India, being a developing nation, is also stepping up to build an ecosystem for entrepreneurs through funding and policy decisions. In the last two decades, tremendous changes occurred in the entrepreneurial ecosystem in India. A lot of opportunities are popping up through government and non-government initiatives. In India, more and more women are moving towards being an entrepreneur, which gives them both a position and a good role in society. Women, unlike men, faces huge obstacles in their career growth owing to the detrimental mindset prevailing, which they must overcome and really be compared with men in terms of workmanship. Through this research, we found that women, in particular, rural women already possess indigenous knowledge added with skill and have potential with some amount of resources to establish and manage an enterprise. Also, they can perform wonders if they are supported with proper tools and techniques owing to their active and competent mindset, involvement in multiple entrepreneurial activities. Henceforth we strongly recommend the arrival of rural women of India into micro-enterprises, and this should be encouraged in policy level which will not only leverage the societal betterment but also will support rural economy in all developing nations. We do feel that the major and primary encouragement should come with the formation and strengthening of rural entrepreneurs’ network, which is needed for knowledge development. They also support in enhancing the developmental activities and help in promotion. Formation of those networks helps rural women in imparting skill and knowledge through the dissemination of content via lectures. Also, technical expertise concerned with producing, processing, managing, procuring and marketing between peers can also be imparted through discussions and knowledge sharing sessions. Hence, we conclude that these efforts will not only motivate the rural women to engage themselves in micro-entrepreneurship if they are provided with the right assistant but also will strengthen their capacities besides increasing their rural household income. With this in mind, we wish to persuade other researchers, academic and policymakers to setup rural Women Technology parks to evolve a mechanism to pool the available indigenous technologies and offer the same to various users. It is pertinent that if such a WTP is established, it will serve as an
interface between various users, technology developers and will enable them to understand and adapt various technologies. This will not only enhance productivity but also will increase overall production and provide good employment potential assisted livelihood. WTP clusters associated with certain technologies and interventions are established already via PURA (Provision of Urban Amenities to Rural Areas) strategy, which is a concept floated by Dr. A.P.J Abdul Kalam, former president of India.

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