A Model for Renewable Energy Based Agro-processing Technology Transfer

S. N. Ndirangu, C. L Kanali, U. N. Mutwiwa, G. M. Kituu

Abstract - The term technology transfer has been viewed different by different writers and researchers. One wider encompassing view is where Technology Transfer (TT) begins during the development of an innovation, continues through its dissemination, and extends into its early implementation. A distinction is also made between horizontal and vertical transfer. The paper mainly views technology transfer from vertical integration and from a wider perspective that includes; Technology development, technology dissemination, and technology adoption. Technology transfer is one of the ingredients for the development of technological capabilities of enterprises. Most Samll and Medium Enterprises (SMEs) including those using rrenewable energy and agro-processing technologies lack technological capabilities and require effective technology transfer.
Some of potential renewable energy based agro-processing technologies energy for use by SMEs are solar drying and evaporative cooling. The two technologies have not been effectively introduced or adopted due to various technical and socio- economic reasons, and adoption and usage still remain low in Africa. One major challenge to their use is poor transfer efforts. Review of various models show they are diverse in their visualisation of technology transfer, and one need to consider characteristic variation of involved institutions and technologies at each of the stages of development and commercialization.
The paper has attempted to develop a model for technology transfer that could be used to transfer renewable energy based agro-processing technologies. The study identifies the elements of some models used by selected players in technology transfer of renewable and agro-processing technologies in Kenya. The best elements are incorporated into a consolidated model that also factors other elements from literature review. The formulated technology transfer model has three components; planning; the technology development; and the dissemination and adoption components. Such a model can be used by different organisations that are engaged in technology transfer and could be ideal for renewable energy based agro-processing technologies including greenhouse solar dryer.

Keywords: Model, Technology Transfer, Agro-processing and Renewable Energy, Greenhouse Solar Dryer.

I. INTRODUCTION

Technology development institutions have multiple tasks; for example research orgainisations like universities have core roles of teaching and research; with commercial opportunities as one of the by-product of these undertakings. There exits many product and inventions from these institutions which can be commercialised to maximize value. This calls for optimal methods to achieve such commercialisation; without for example compromising on the quality of main products. One way to enhance commercialisation is through effective Technology Transfer (TT). The document analysis existing models of TT and attempts to develop a practical model of Renewable energy based agro-processing technology transfer. It analysis more the technology transfer issues and only slightly covers other supportive issues.

A. Innovation, Diffusion, Dessimination and Technology Transfer

Innovation can be loosely described as a new process, product, service, design, form of organization, or function of production that may lead to productivity increases and widespread market adoption and expansion [24]. Technology on the other hand is word a that takes several meanings; with the broadest and fundamental meaning being whatever civilisation takes to sustain itself. Technology by itself can take the form of an object (material technology) or a concept or technique (social technology) [2]. [26], dscribes technology as systematic knowledge for the manufacture of a product, for the application of a process or for the rendering of a service; and further explains that technology "includes not only "knowledge or methods that are necessary to carry on or to improve the existing production and distribution of goods and services"or indeed to develop entire new products or processes, but also "entrepreneurial expertise and professional know-how".

Technology transfer and diffusion are two aspects of technology dessimination, which is the process by which innovation is transmitted from a donor to a reciever. Technology transfer involves communication between a specific donor and a specific recipient or group of recipients. In technology diffusion the donor is not aware of who the recipient may be [22].

Technology transfer has been viewed differentrently by different authors and researchers. [26] defines Technology transfer "as the process by which commercial technology is disseminated". This takes the form of a technology transfer transaction, which may or may not be covered by a legally binding contract, but which involves the communication, by the transferor, of the relevant knowledge to the recipient. [6], takes a narrower view of technology transfer to refer to the handing-off of intellectual property rights from the university to the for-profit sector for purposes of commercialization. According to [7], Technology transfer (TT) can be broadly defined as the process of converting scientific findings from research organisations into useful products by the commercial sector. The report says TT is also known as "knowledge transfer or knowledge sharing" and is the process whereby an enterprise converts scientific findings from research laboratories and universities into products and services in the marketplace. He notes that TT can take three main channels (Figure 1): The creation of new companies (spin-outs), which often involves some

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transfer of personnel (mobility of researchers); collaboration between universities, research organisations and industry notably via research contracts; and/or licensing of IP.

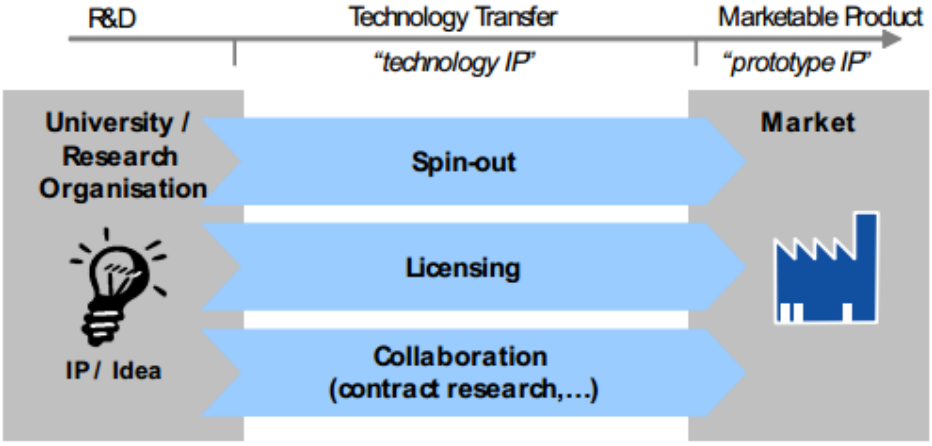

Figure 1: TT Model
Source: [7]

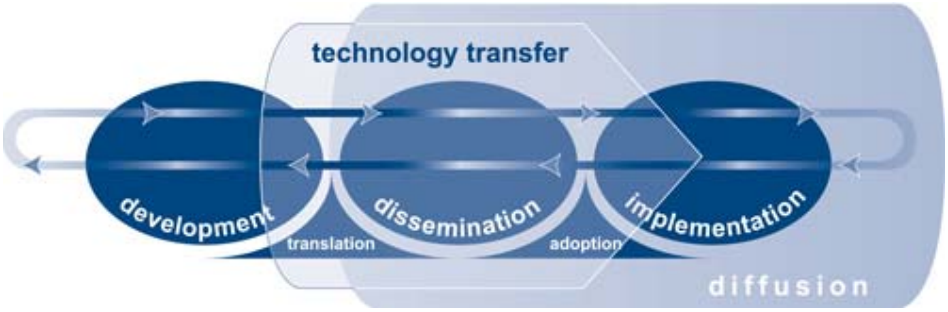

Figure 2. Alternative TT Model
Source: [11]

The view taken by [11] encompases a wider view of technology transfer as a multidimensional process that intentionally promotes the use of an innovation. Technology transfer begins during the development of an innovation, continues through its dissemination, and extends into its early implementation. According to [11] this process requires multiple stakeholders and resources, and involves activities related to the translation and adoption of an innovation. Technology transfer is designed to accelerate the diffusion of an innovation[27], takes a similar wider view of technology transfer, but makes a distinction between vertical and horizontal transfer; where vertical transfer is said to refer to technology being transferred from research to development to production. Thus it follows the progressive stages of invention, innovation and development, with the technology becoming more commercialised as it proceeds through each stage. Vertical transfer can be within one organisation or a transaction between, say, a research institute and a manufacturing company. Horizontal transfer refers to an established technology being transferred from one operational environment to another. The technology is already commercialised and the purpose is to disseminate the technology and extend its application into other contexts.

This research adopts the wider view of technology transfer. The paper attempts to develop an appropriate TT model that could be used for transfer of renewable energy based agro-processing technologies in Kenya When properly implemented, such a framework would support technology development, skills improvement, dissemination and adoption of targeted technologies.

B. Enhancing Technological Capabilties Through Renewable Energy Based Agro-processing Technology Transfer

Most Governments today regard renewable and agro-processing technology integration in agricultural and related sectors as key to enhancing high growths of these sectors; diffusion and adoption of such technologies is an important route to increased competitiveness, especially for the SMEs. However, SMEs have disadvantages related to the lack of technological and financial capability which can lead not only to problems in their ability to source technology but also in their capability to absorb it into their organization and diffuse it into their industrial sector [18].

Some of the renewable energy based agro-processing technologies that have majaor potential use in SMEs includes solar dryers and evaporative coolers. Solar drying

is an important process in the agricultural sector that has been used to undertake value addition to most agricultural produce [10], [1], [4], [29]. It is a renewable energy and hence helps to protect the environment; it also has the advantage of saving cost, reducing electricity and fossil fuel consumption. However, solar dryers have not yet been effectively introduced or adopted due to various technical and socio- economic reasons, and their adoption and usage still remain low in Africa [2]. Major challenges contributing to this includes; technical challenges including limitations in capacities and low efficiencies, poor promotion efforts, and financial challenges [19]. One upcoming solar drying technology is the greenhouse dryer which according to [29], if optimally designed can help overcome a number of challenges with most drying systems. Another pontential renewable agro-processing system is the charchoal cooler, an evaporative based system that can be used to help preserve vegetables and fruits [28], [20]. Despites its pontential, the system have not well being adopted. If well transfered these two systems would be effective technologies in the agriculural sector.

PHOTO 1 (a): Evaporative Charchoal coolers in Makueni, Kenya PHOTO 1 (b): Front view of such a cooler

Photo 2 (a). Green House dryer at Kayatta, Machakos 2 (b). Green house dryer at Nakuru

Renewable energy and food processing technologies like other technologies require effective transfer. Effective technology transfer depends not only on the intrinsic capability of the technology itself but also on whether institutional and cultural factors help the adoption of the technology. Both technological and non-technological barriers hinder technology adoption. The technological factors includes; inappropriate technologies push, lack of appropriate technologies (too big, expensive technologies, too experimental) while non-technological factors includes lack of adequate training to recipient of technology and lack of maintenance. There is therefore need to utilize appropriate models to develop and transfer technologies.

Technology transfer is one of the ingredients for the development of technological capabilities of SMEs and other enterprises (figure 3), but it cannot by itself develop them. Other complementary requirements are: (a) conducive government policies; (b) effective learning strategies and ability to learn at the level of enterprises, and (c) a favourable learning and innovation context (local clusters of competitors, suppliers and customers, active trade associations, supporting institutions for training, development and application of technology and financing) [27].

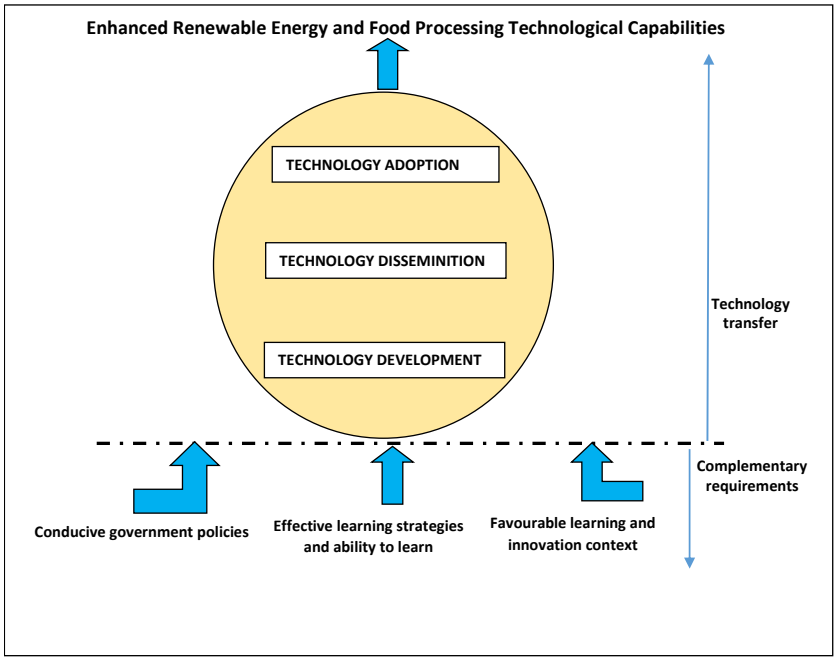

Figure 3**:** Framework for Enhancing Technolgical Capability

[6], notes that the primary reason technology transfer is undertaken for example by research institutions such as universities is to enhance the likelihood that new discoveries and innovations, new uses of physical materials, and new applications of science to solve problems in the different sectors, will actually lead to useful products, processes and services throughout the world economies. Technology transfer also propels new research collaborations, exchanges of materials, information and personnel with industry, adding new dimensions to organisation's research programs and, at the same time, offering unique research opportunities for example to faculty and students, incase of universities.

II. REVIEW OF LITERATURE

A. Technology Transfer Components

Technology development: Technological innovations derive from multiple sources, not only from the laboratories and research stations. These sources include research-minded farmers, innovative research practitioners at the local level, research-minded administrators, NGOs, private corporations, and extension agencies. Technology development should be seen as a complex, multi-stranded, and multi-directional process, involving many actors other than scientists in the formal research system.

Technology dissemination**:** This can be better conceptualized by understanding the role of various organizational arrangements and communication techniques in persuading users to adopt a recommended technology. Even a good technology is not necessarily automatically adopted by users; and there is need for deliberate efforts to promote such technology to enhance its transfer. For technologies to be adopted by users various considerations need to be put in place; coordination efforts should be there to ensure such technologies come from research institutions; technologies need to be introduced in most effective ways; all ingredients such as cost need to be brought out; there is need to adopt participatory methodologies; there must be regular monitoring; good linkages must be developed and strengthened; and lessons learnt should be adopted for improvement, amongst many other considerations [8].

Technology adoption: Adoption is the actual implementation of new technology at the users/firm level. Users of technology and their decision-making is generally a bit complex. Potential technology users or adopters have multiple objectives and select different strategies to pursue these objectives with the resources available to them. Both the objectives and the available resources vary between potential users and change over the life-cycle of the user. Potential adopter in the same environment may have different objectives and livelihood strategies, and so respond differently to a given technology**.**

The conventional adoption framework simplifies the analysis of the adoption-decision by its implicit assumption of an individual 'decision maker'. At the household level the ability to make decisions regarding resource use and technology varies according to age, gender, and other categories, and actual decisions can depend on a complex bargaining process among household members. Beyond the household, group processes and the ability to harness them can play a crucial role in adoption decisions.

B. Review of Existing Models From Literature

Several models have been developed for conceptualizing technology transfer; normally referred to as Technology transfer (TT) models. The traditional models earlier developed included; the Appropriability Model; The Dissemination Model; The Knowledge Utilization Model and the Communication Model. Modern models have later been conceptualized; one modern model that captures the basic aspects is the Sung and Gibson's Model [25]. This model proposes that Technology Transfer (TT) consists of three levels of involvement: Level I (Technology

Development), Level II (Technology Acceptance), and Level III (Technology Application). Technology Development is considered as the most important level where the transfer process is viewed as passive through transfer means such as research reports, journal articles, and computer tapes. This level relates to the appropriability model: where the emphasis is on the importance of quality of research and competitive market pressure in achieving technology transfer.

In the Technology Acceptance level the technology developer is responsible in making certain that the technology is made available to the receptors that can understand and potentially use the technology. This level of involvement relates to the dissemination model: where the concentration is on disseminating innovations to individual users.

Technology Application level is the most involved level of TT. Technology application includes commercializing the use of technology in the marketplace and other application such as intra-firm processes. This level equates with knowledge utilization model: where emphases are on the critical element of interpersonal communication between technology developers and users, and the organizational barriers and facilitators of TT. According to [5], the technology transfer can be visualized from three perspective; Technology development, technology dissemination and technology adoption.

[9], proposes a model for technology transfer, and thus industry-relevant research, where he notes that transfer involves more than merely producing research results and delivering them in publications and technical reports. It demands close cooperation and collaboration between industry and academia throughout the entire research process and that to include: overview of research approach and technology transfer model; identifying potential improvement areas based on industry needs, through process assessment and observation activities; formulating a research agenda using several assessments to find research topics, and formulate problem statements while studying the field and the domain; formulating a candidate solution in cooperation with industry; conducting lab validation (for example, through lab experiments); performing static validation (for example, interviews and seminars); performing dynamic validation (for example, pilot projects and controlled small tests); and releasing the solution step by step, while remaining open to smaller changes and addition.

A model is recommnded for technology transfer that integrates organsiation arrangement and the technology components. The model proposes that an ideal technology transfer model for promoters and practitioners for developing their own programs is that which; has a provider who possess a technology and willl to transfer; a mechanism to effect the transfer; and a user that is willing to recieve technology. The model identify that there is an organsiation with strategic thrust that is works with other organisatsion to deliver technology transfer. The model identifies evaluation stage as the starting point in technology transfer, where needs and solutions are prioritised. It also differentiate two types of technology source; research and development and existing technologies; but doesnt identify the reverse engineering aspects of technology transfer.

The models emphasise the need for feedback mecahnism on usage and on developed technology to the organsiation and the research team; for user to transmit his or her capability so that TT mechanism can adjust the process or technology can be adjusted to fit the users need.

It also identifies the need for market planning, packging of product and services and the need for a promotion development mechanism.

The model incorporates the users and links them to the implementaion and adoption phases and recognises their role in providing feed back. It appreciates that the user is the center of the process and has ideal input in; development and refinement of technology, dessimination of crucial information in a form suitable to attract user interest, transation from of state of the art to the practice, adoption of technology to local condition and in adoption of common parctice. The model does not emphasise the role of financial linkages, the inputs in the technology development, the need for a technology transfer office, the options to enhance capacity of users such as incubation and the need to factor in the IP component.

[3], noted that a generalizable model of technology transfer is difficult to find, and one that accurately depicts the subtleties of how knowledge and technology are transferred in practice is arguably non-existent. The study analysis the traditional linear model of technology transfer and concludes that its its insufficient; and proposes a model that has a mechanism to remove technolgy transfer barriers such as insufficient rewards for university researchers, university-industry culture clashes, bureaucratic inflexibility, unskilled and understaffed Technology transfer offices, lack of entrepreneurial talent throughout the university, the perception of declining federal R&D support, and the concern that university-industry cooperation will interfere with academic freedom, and—arguably—the existence of the traditional linear view of technology transfer itself; for example it proposes an appropriate organizational structure that include a specialized and decentralized TTO with sufficient autonomy to develop relationships with industry. It emphasis the Intellectual Propert (IP) process in technology transfer; protection and licencing of technology. The model only concentrates on technology invention part of technology transfer

[7], indicated that technology Transfer often involves a formal transfer of rights to use and commercialise new discoveries and innovations resulting from scientific research to another party. The TT process also covers funded research, innovation disclosure, patents, licensing and sometimes new start-up. Returns on TT are primarily in the form of licensing royalties, but also include sponsored research, one-off transactional fees and new venture equity ventures. The model recognises the need for funding requirements and the TTO.

The review of these models shows diversity in their visualisation of technology Transfer. Secondly according to [21], there is a need to acknowledge characteristic variation among the institutions at each of the stages of development and commercialization when attempting to identify mechanisms and strategies for technology transfer. [23],

notes that Transfer of technologies (TT) takes place among various kinds of players, takes on various kinds of modalities and is done for various motivations

III. METHODOLOGY

The study attempts to develop an appropriate model that could be used for development and transfer renewable based agro-processing technologies in Kenya. The study focuses on the technology transfer issues and slightly covers other supportive issues such as supportive policies and players. It doesn't also look at post adoption aspects like issues related to enhancing marketing capabilities of enterprises adopting the technologies

The study analysis existing technology transfer models from literature and models used in agro-processing and renewable energy technology transfer by some institutions in Kenya; public and private technology development and promotion organisations and organisations involved in financing such technologies. The best elements from these models are incorporated into a consolidated model.

IV. MODEL DEVELOPMENT

A. Analysis of Some Selected Models in Kenya

Activities of some organisations that participated in a workshop at JKUAT and which are involved in renewable energy technology development and transfer were analysed to isolate out the unique elements that could be factored into a consolidated TT model for renewable energy based technology transfer. The study identifies some of the elements of the models that can be included into the consolidated TT model. It first identifies two broad model of technology transfer; the public and the private sector models;

General Public Sector Model: In this model the trigger of the intervention will normally be need based-for example from an emerging problem, from government policy or through need assessment study. The technology development builds on new knowledge, existing knowledge and socio-economic information to develop designs. The process of technology transfer is normal; design, prototype type production, user trials, modification of tested technology, final trials, and dissemination to users and fabricators. It also includes cost benefit analysis. The technology could be released after training of artisans for mass production and who sell their fabricated technologies, or through sale by either the innovators or developers themselves. (Figure 5).

The general Private Sector Model: Has a number of elements as of public sector modes, but has variation in the trigger mechanism, that is based on potential assessed demand by users or request by users. The solution to the problem is through technology development or importation. In this model, the imported technologies are at times modified for local use, but are normally sold directly. The technology is availed to user through distributors who sell directly the imported technologies or the modified technologies (figure 6)

Another model that was analysed and its elements identified is the Sustainable Community Development Services (SCODE) Model. SCODE is a community based NGO that promotes diverse renewable energy technologies that are affordable to target community. The models has unique aspects that include; participatory approach to technology transfer to overcome social barriers, working with local suppliers and producer for capacity building and marketing of products; use of social marketing campaigns and networking activities to create demand; working with research institutions and the private sector in test-marketing new products and improving marketing strategies; technology standardization; benefits focused promotion; and gender mainstreaming. The organisation also engages in partnership and networking with over 25 partners. The TT here incorporates; capacity building and technical assistance; successful outreach and education models; market-based solutions that promote local business development; and knowledge management through publication of quarterly bulletin.

The Songa Mbele Community Development Initiative (SoMCoDI) organisation has also a model that has some aspects that can be integrated into a TT model such as; focusing on livelihood improvement practice (LIP), that involve undertaking improvement of existing physical facilities and situation without relying highly on advanced technology demanding large amount of funds. It also focus on mobilization and utilization of locally available resources. There is a major focus on poverty reduction and food security promotion, economic empowerment of women, men and youth. The organisation promotes diverse agro-processing and renewable energy technologies such as fireless cookers. It has a component of incubation of budding enterprises. Mainly it uses the group approach for capacity building and transfer of technology and has strong collaboration with researchers, NGOs, financing institutions, public institutions, private sector and buyers. It has a centralized management with a country outreach

The financing models that were analysed were the Business Initiatives and Management Assistance Services (BIMAS) Model and the Kenya Women Finance Trust (KWFT) model. The BIMAS model components includes; provision of basic need to low income earners in water, energy and education; use of diverse multiple packages tailored for different sectors; gender; growth of investment; piloting interventions in specific micro-region and later use of stepwise expansions for wider regional coverage; focusing on employment in the rural areas; and convergence of interest between the community and donor. In the KWFT model the focus is working with women; intensive coaching, training and use of experts; heavy investment on supportive infrastructure; diversified range of product offerings in renewable energy including solar, stoves, electricity connections, greenhouse and biogas. The KWFT model of financing these technologies involves working with stockists, established organisations such as Kenya National Federation of Agricultural Producers (KENFAP) and Improved Stoves Association of Kenya to transfer technologies. It has identified these suppliers, partners and stockist to ensure quality and standard products. The user is financed directly or through direct payment of supplier (figure 7).

B. *Illustration of some of the analysed models:*

Kenya Women Finance Trust (KWFT) Financing Model for TT**:** The Kenya Women Finance Trust is a microfinance institution established by Kenyan women and offering services only to low-income Kenyan women. It is a deposit taking microfinance whose services are open to all Kenyan women and, by extension, to their families. The model used by the organisation for finacing technologies is as in figure 4.

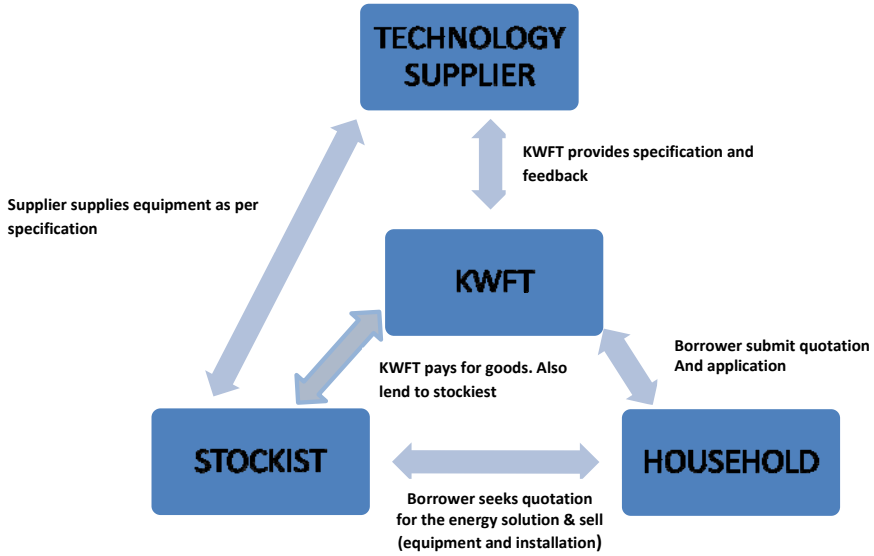

Figure 4: KWFT Model

Source: [14]

Public Sector Model: This model (figure 5) has been (partly) applied in public organisations such as: Kenya Industrial Research Developemnt Institute (KIRDI); Universities like Jomo Kenyatta University of Agriculture and Technology (JKUAT); Ministry of Agriculture-Rural Technology Develomemnt Centres; and Kenya Agricultural and Livestock Research Organsiation (KALRO).

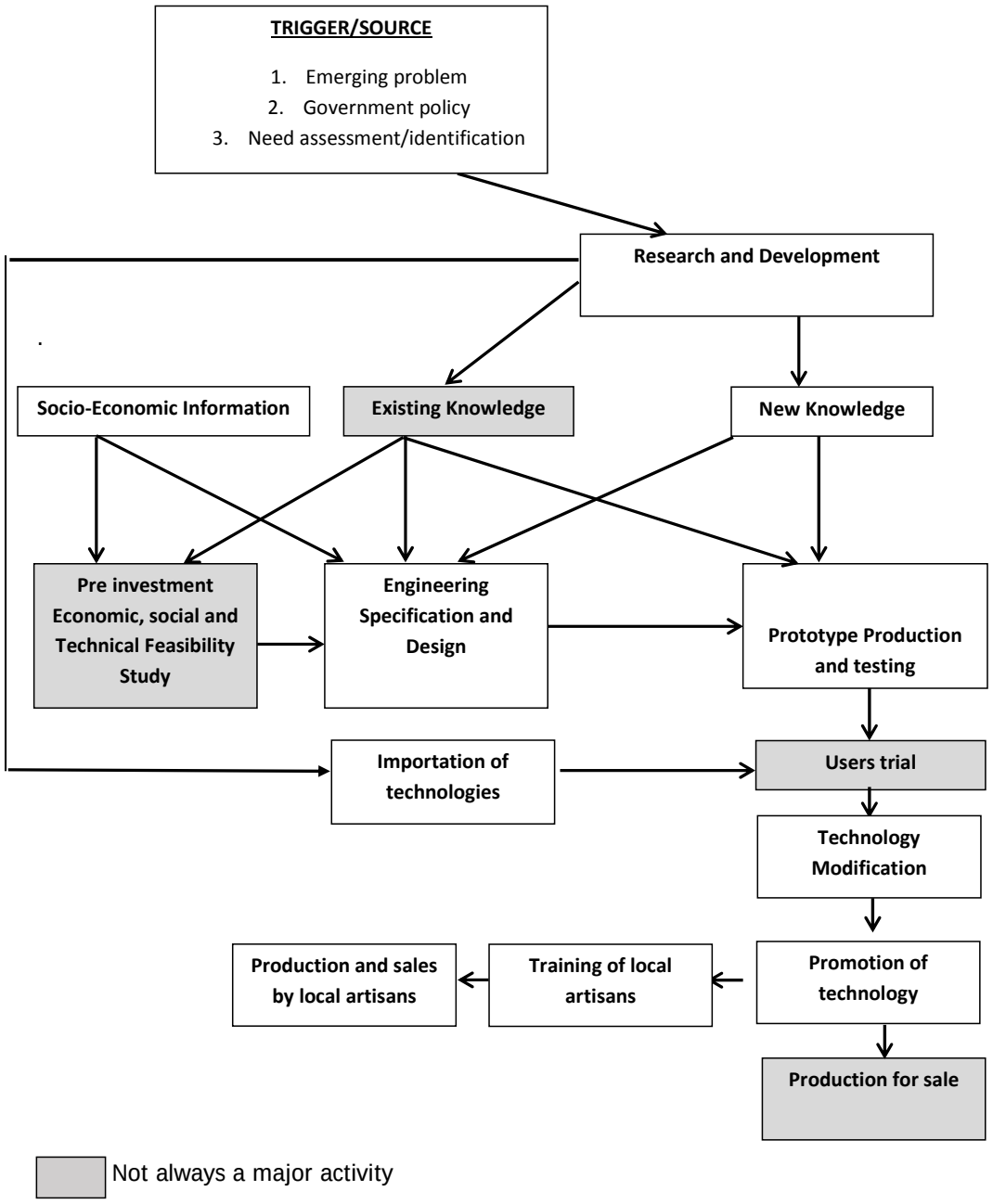

Figure 5: Public Sector TT Model

Source: [15]

The Private Sector TT Model**:** This is mainly common with private sector organisations. Examples of organisation that use (part of) the model include: DK Engineering, Muharata Enterprise, Kijito (wind) company, Ballon biogas sales company and dealers such as BraziAfica, Hubei Ltd, and Marina Machineries

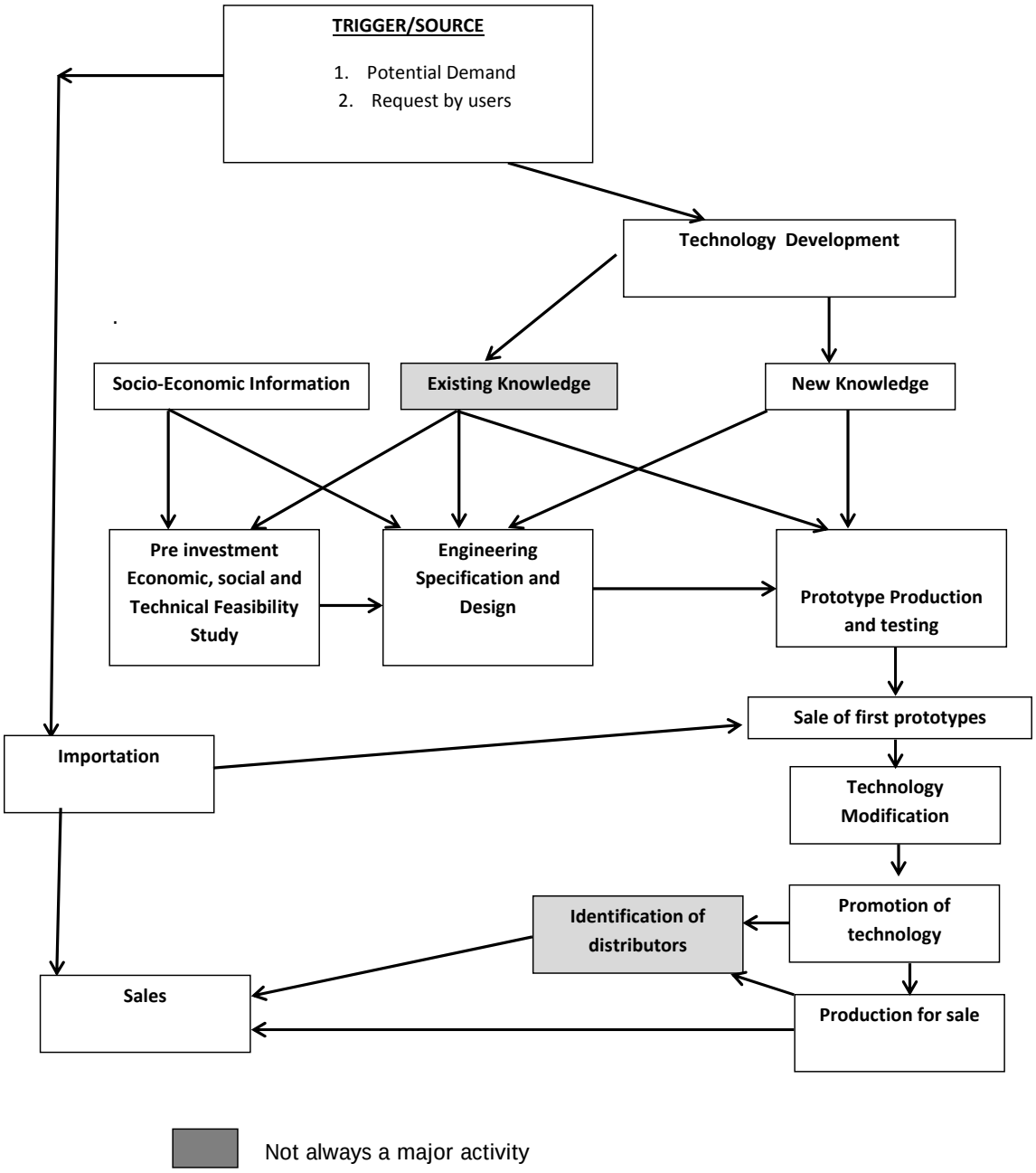

Figure 6: Private Sector TT Model
Source: [15]

C. Proposed Consolidated Model for Technology Transfer

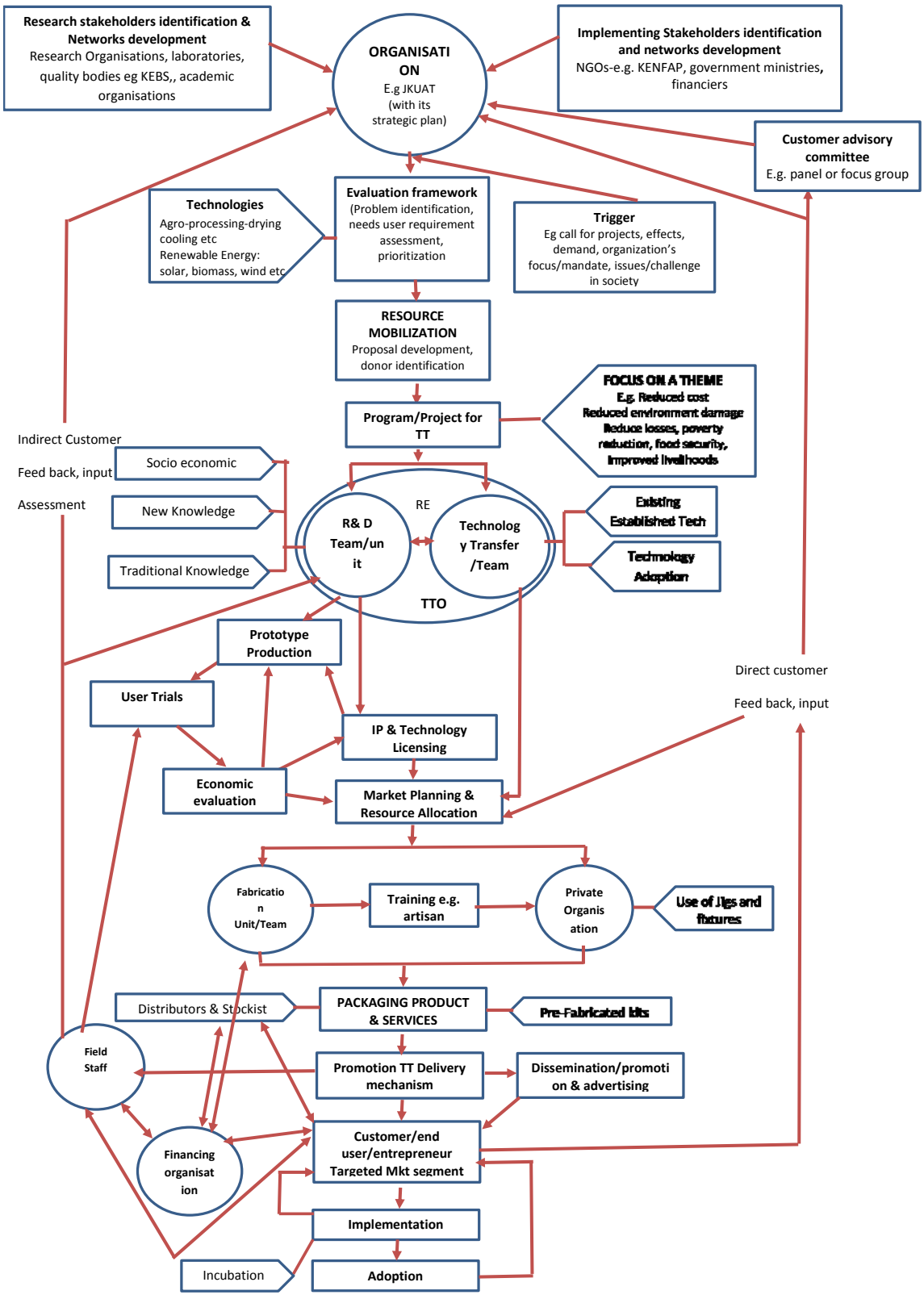

Figure 7: Proposed Consolidated model

D. Framework of the Proposed Model

The model borrows the following aspects from the models discussed in table 1 and also incorporates input from models reviewed in literature. It illustrates a possible TT model for renewable energy based agro-processing technology. The organisation under which the TT implementation will be undertaken has its thrust in relation to what it intends to transfer; this could build out of the organisation's mandate or internal policies like technology development and revenue generation. The following are the phases of the proposed TT model:

1. Planning**:** Most organisations will have established networks and collaboration with other stakeholders or organisations in the area of focus; for this study the focus being renewable and agro processing. Such collaboration would be with NGOs and private sector institutions with similar mandates or interests. For renewable energy based technologies such stakeholders would include government institutions engaged in research such as KIRDI, Rural Technology Development Centres of Ministry of agriculture, Universities, KALRO and Energy centres of Ministry of energy. Such NGOs as SoMCODI, KENFAP etc. would be ideal to work with as well as private companies such as Muharata, and banks etc. It is ideal that such organisations continue to enhance and broaden participation. The implementing organisation will have its strategic plan; with vision, mission well spelt out. An advisory committee need be in place to assist in the planning and liaising with stakeholders

2. Technology evaluation: There must be a trigger to initiate the thinking on the issue to be handled through TT; the trigger could be the organisations mandate, or demand for solution based interventions. The problem and needs should be identified, and normally several needs will emerge; these needs should be prioritized. Various solutions will then be drawn for the prioritized need and these too need to be prioritized after assessing each of them.

3. Resource mobilization: Once the idea has been prioritized the organisation will mobilize the resources within itself or through external finding; one way being to develop a fund seeking proposals. This will lead into a project or program. The focus for such need be brought out to relate with the donors mandate or organisation areas of focus or manadate. As from the models evaluated the focus of the project can be through either one or many of the following broad objectives: environmental conservation; poverty alleviation and food security; livelihood improvement practice; improved productivity; sustained economic growth and employment in rural areas; provision of basic needs through renewable energy; energy, water, food; and integration of renewable energy and food processing amongst other objectives. This aspects could also be visualized as the triggers of research and development and ultimately technology transfer.

The developed interventions for the project could have some of these aspects: community driven projects or participatory engagement; targeted at local institutions (SMEs and cooperatives); product diversification and energy mix with multiple packages; market based interventions; convergence of interest between the community and donor; use of local partners to build capacity; social marketing campaigns; technology standardization; benefits focused marketing; and gender mainstreaming; partnership, networking and collaborations; nurturing/incubating budding enterprises; stringent procedures particularly on financing; value chain focused; reverse engineering; external local or foreign financial and technical support amongst other aspects

4. Technology development**:** Ideally the activities related to technology development will be handled by the technology transfer office (TTO). The technology identification and development need to involve the users all through. There is therefore need for continuous communication between stakeholders involved. Technology for TT will be available through R&D where the input will be new knowledge, traditional knowledge and socio economic consideration. It could also be through existing technologies; already established in another area or through technology to be adopted from other uses. It is important that R&D be undertaken through team work. Once the technology has been developed it will be tested in the workshop or laboratory and after confirming performance, prototypes will be made and this will be tested through users' trial that are undertaken through specific users and regions. There is need for techno- economic evaluation of the technology after such trials. The technology need to be modified after users' trial and then go through IP process: patenting and licensing. The patenting and licensing could also be immediately after R&D and laboratory testing. Technology development could also entail reverse engineering where existing technologies are modified. The existing (e.g. imported) technology could either be tested with users before modification or immediately be modified to suit local conditions.

5. Technology dissemination and adoption: Market planning and resource allocation for technology dissemination starts with visualizing who will spread the technology and who will undertake the activities that follow. Such responsibility would be through the parent organisation's fabrication unit or through private organisations who will be trained; such training could involve development of jigs and fixtures. Depending on the complexity of the technologies, producers of technologies could be local artisans or well established fabricators. Market planning is also meant to have the product in actual market place and also identifying who the user will be. The products should be well packaged in a way suitable to be received by users and audience; e.g. by use of manuals, videos or pre-fabricated kits. The service that accompany products should enhance availability and usage of the product: for example there is need to identify the distribution channels.

The product need to be promoted through a well-defined TT delivery mechanism. The methods of dissemination could be advertising, exhibitions, demonstrations or training forums where the target is the end user, or the entrepreneur, or the targeted market segment. Promotion could also be through field teams who could be led by parent organisations or other organisations e.g. ministry of agriculture or energy.

Such teams should draw people from implementing organisation and other key players such as extension staff, and researchers.

Facilitating technology transfer also requires linking the users with financial organisation. The financial arrangement could be such that borrowers or buyers of technologies seek quotation from technology suppliers (stockist or distributors) or organisation itself. They can then get financing directly or the supplier is paid directly by the financier. The arrangement could also be such that financier request specification from users, gives this to the supplier and pays supplier directly. Technology supplier need to work with stockist and distributor to ensure right specification get to the user.

The end user or customer, to who promotion is done, could vary depending on users organisation set up; for example it could be done to managers or the technicians.

6. Implementation: There is need to have continuous dialogue between users and providers of technology, like to have continuous supportive services being provided to users. One key area of implementation is to assist groups to familiarise with technology; this could be undertaken through incubation or practical training of end users.

7. Adoption**:** This occurs when measurable change takes place when practice is affected or when wide spread use of technology has been achieved. The user feedback is crucial at this stage and the organisation need to be aware of this. Feedback could be directly or indirectly; through users or field staff respectively. The field staff gives feedback to R&D team or to the implementing organisation.

V. CONCLUSION

A model has been develoepd that can be used for transfering renewable energy based agro-processing technologies. The formulated technology transfer model has three components; planning component that emphasise the need to have stakeholders involved and the need to have and follow organisational strategic direction; the technology development part that highlights an ideal process of technology development and which that calls for the need of a technology transfer office, the need for user trials and need for economic evaluation; and the dissemination and adoption part that emphasises the need to identifying responsible players, the packaging of the product, the need for incubation and linkages with suppliers and financing organisations. Such a model can be used by organisations that are engaged in technology transfer. It could be ideal for renewable energy based agro-processing technologies including greenhouse solar dryer.

VI. ACKNOWLEDGMENT

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