Executive Summary

The main aim of the present study is to contribute to a better understanding of the potential impact and of the limitations of solar photovoltaic (PV) applications on sustainable agriculture and rural development (SARD), with a special attention to the effects on income-generating activities and social welfare.

Outline of the document

The results of this study are presented in such a way that readers can select to go directly to their areas of highest interest. Chapter 1 presents the introduction and objectives. Chapter 2 provides the background to this study. Chapter 3 contains the main results of this study and presents the major applications of PV systems in rural areas and their (potential) impact. The Chapter is organized by sector of rural society (household, social and communal services, off-farm productive activities and agriculture), and further subdivided into main applications. Some illustrative examples are worked out in text boxes. Chapter 4 summarizes the findings and highlights some of the most important suggestions and lessons learnt to use the opportunities of PV systems for SARD. The annexes contain more detailed information on a number of issues discussed in the document, such as a package of recommendations to promote PV for SARD, the survey questionnaire and a list of references.

Chapter 1

Chapter 1 identifies the objectives and scope of the study, clarifying its limitations and stressing the need for a better understanding of the potential contribution of PV applications to rural development and the need for further research, in order to gain further financial and political commitments for PV programmes.

Chapter 2

The important links between energy, sustainable agriculture and rural development are briefly discussed in the first Section. Energy is seen as an important input to the development process, not as an end in itself, but as a means for providing necessary services in the different sectors of rural society: households; agriculture; off-farm productive activities (cottage industry and commercial services); and communal and social services (for example, potable water, health care, education). Section 2.2 briefly discusses the experiences with electrification in the context of rural development. Section 2.3 gives an overview of technical and organizational developments in relation to PV rural electrification. Section 2.4 describes more explicitly some of the lessons learnt in three decades of PV applications, especially regarding institutional aspects and the current and emerging markets for PV systems.

Chapter 3

On the basis of surveys, literature, project documents and interviews with practitioners and key players in the PV field, the most important applications are discussed, both in terms of present use as in terms of (potential) impact, focused on productive applications in rural areas of developing countries. The following is a brief synopsis of this discussion.

Solar Home Systems (SHS) are still the dominant PV application in rural areas of developing countries and their main use is for lighting and radio/TV in households. Some studies report that there is little evidence for direct economic impacts by SHS on households; other studies indicate an increase in income generating activities and make reference to time savings and extension of the day due to SHS. This "surplus time" is sometimes used for productive activities such as sewing, basket weaving and handicraft making. In other cases this "surplus time" is used for facilitating household chores, homework, education and recreational activities. In addition, indirect economic benefits often arise from improved access to information, and increased quality of life standards related to household electricity services.

Many PV projects have been and are being implemented for **social and communal services**, such as provision of potable water, health centres, education and communal centres. PV has often shown to be the most cost-effective solution for improving such services in remote, unelectrified areas of developing countries. Through these services, PV systems can have a significant impact on the lives of *all* rural inhabitants, provided attention is paid to the access of the most marginalized groups to these services. At times, the provision of social and communal services is also able to spark the provision of income generating activities.

Small solar systems also help develop **off-farm productive activities** in many countries, such as bars, restaurants, rural cinemas, telephone shops, technical and artisanal workshops, by powering small tools and appliances (drills, soldering irons, blenders), lighting and radio/TV. The installation and maintenance of PV systems and sales of PV electricity has been shown to contribute to rural employment creation. In this sector, there is scope for further investigation of the potential for PV/wind and PV/diesel hybrid systems.

PV systems are also increasingly being used for **agricultural applications**. Some of these applications, such as livestock watering and PV electric fences are already widely available commercially. Applications such as PV-powered drip irrigation systems are finding increasing niche markets. Interesting applications such as pest control, aeration pumping for aquaculture, fish and poultry lighting have to be investigated further to prove their replicability. Successful examples exist of PV/diesel and PV/wind hybrid systems to economically power agricultural applications that have a higher energy consumption.

Chapter 4

The last chapter summarizes the findings. These findings have led the authors to believe that the time is now ripe to advance to a new phase of "**PV beyond the light bulb"** directed at fully exploiting the potential of PV systems for SARD, reaching wherever feasible the electricity demand beyond households lighting. Recommendations are presented to facilitate the implementation of the opportunities this presents, including a call for intensified cooperation between institutions from the energy, agricultural and rural development sectors to take up these opportunities. While recognizing that the main responsibility for action lies

with national development authorities, the role of technical cooperation agencies such as FAO in supporting these national efforts is addressed.

PV applications, and especially those for productive activities, have considerable potential to serve both environmental concerns (e.g. climate change) and improve the situation of the inhabitants of impoverished rural areas in developing countries. Reference is made to FAO's commitment to tapping this potential in the process of promoting sustainable agriculture and rural development in developing countries. As a follow-up to the conclusions and recommendations to this study, it is recommended that FAO actively looks for cooperation and alliances with other interested parties.

The preparation and publishing of the present study represents an assurance of the interest of FAO to assist its member countries in taking advantage of the opportunities offered by developments in the PV field for sustainable agriculture and rural development. Recalling the importance of cross-sectoral programmes as a strategy to maximize the benefits of PV applications, the study will hopefully contribute to underscoring FAO's role in promoting the integration of PV systems in agricultural development programmes and of agriculture into ongoing PV programmes.