Participatory GIS in Empowering Rural Communities:  
A Framework for Iterative Development and Evaluation

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Abstract
Participatory GIS empowers rural communities to visualize and understand various problems facing them and their solutions. Such systems however need to be easy-to-use and effective to deliver their intended benefits. Towards this goal, GIS need to be simplified so that they can be used by villagers without much technical assistance from experts outside their community. While there have recently been some efforts in this direction, GIS that would provide this kind of simplified functionality are still rudimentary. A framework for iterative development and evaluation of such systems is described.

Keywords
Participatory GIS, Ease-of-use, Effectiveness, Framework, Iterative Development, Evaluation

1. Introduction:
Participatory GIS (PGIS) empowers rural communities to visualize and understand various problems facing them and their solutions (Geertman, 2002; Vajjhala, 2005; Jankowski, 2009; Kolagani et al, 2012a). Such systems however need to be easy-to-use and effective to deliver their intended benefits. Towards this goal, GIS need to be simplified so that they can be used by villagers without much technical assistance from experts outside their community. While there have recently been some efforts in this direction, GIS that would provide this kind of simplified functionality are still rudimentary (Voinov and Costanza, 1999; Voinov and Bousquet, 2010; Eckman et al., 2010; Kolagani et al, 2012b). A framework for iterative development and evaluation of such systems is described in the following sections.

2. Framework for iterative development and evaluation:
The activities of PGIS in empowering rural communities can be broadly divided into two categories (fig. 1):

1. Map production: Making it possible for a reasonable number of villagers from across a wide cross-section of the community to produce GIS maps themselves without much technical assistance from experts outside the community
2. Map utilization: Making it possible for a majority of villagers to utilize these GIS maps to understand and analyze various problems and their solutions and participate in decision making and monitoring of their implementation without any technical assistance from experts outside the community

Both these activities of every PGIS solution need to satisfy certain ease-of-use, effectiveness and software administration criteria for them to deliver its intended benefits. These criteria will be described in the following sections.
2.1. Ease-of-use:

Three criteria can be used to capture ease-of-use of a PGIS solution (fig. 2):

i. Percentage of villagers who can use

ii. Number of days of training needed

iii. Nature of external support needed

2.1.1. Map production:

i. Percentage of villagers who can use:

The map production activity should be easy enough to use so that a reasonable number of villagers (e.g. at least 10%) should be able to participate productively (fig. 3). These numbers should be uniformly distributed (e.g. school children) across various sections of the rural community, so that a few people, or a few sections, of the village do not control the activity.

ii. Number of days of training needed:

Number of days of training needed should be a maximum of 5 days. This should include repeated practice a few times so that the villagers get the confidence to use it subsequently independently. This will need the activity to be easy enough so that it can be learnt by the villagers within one day and they practice repeatedly during the remaining days.
iii. Nature of external support needed:

Villagers should be able to carry on their map production activities subsequently with only remote support from experts outside the community e.g. through web or by phone. Physical proximity should not be required for continued usage. Otherwise the PGIS solution will not get grounded fully.

![Diagram showing framework for iterative development and evaluation of GIS](image)

Figure 3: Ease-of-use of map production process

### 2.1.2. Map utilization:

i. Percentage of villagers who can use:

The map utilization activity should be easy enough so that a substantial number of even barely literate villagers (e.g. more than 50%) should be able to use it (fig. 4).

ii. Number of days of training needed:

Training needed should be for a maximum of 1 day. It should be possible to impart basic training within 1 to 2 hours so that they can practice the remaining time and get the confidence to use it subsequently independently.

iii. Nature of external support needed:

Villagers should not need any support from experts outside their community to carry on their map utilization activities subsequently. The process should be simple enough so that villagers trained in map production process should be able to provide necessary support for map utilization by others.

![Diagram showing framework for iterative development and evaluation of GIS](image)

Figure 4: Ease-of-use of map utilization process
2.2. Effectiveness:

2.2.1. Map utilization:

The PGIS solution should be able to give the villagers a detailed yet easy-to-understand visualization (e.g. multiple simple views) (fig. 5) of complex data underlying the GIS maps, so that they can understand various problems, their causes and solutions and participate in decision making and in monitoring of their implementation. While a few default views can be supplied with the PGIS solution, it should be possible for trained villagers to create and add more custom views as per their felt needs. These views should also be able to capture changes over time (dynamic views) so that villagers can analyze effect of various alternatives before they decide on one solution. Third parties, such as support organizations, should be able to extend and experiment with more static and dynamic views.

![Figure 5: Effectiveness of map utilization process](image)

2.2.2. Map production:

Absolute accuracy (fig. 6) of GIS maps produced need not be high as these maps are more for visualization of various problems and their solutions and not for legal purposes e.g. to settle boundary disputes. However, their 'relative accuracy', e.g. in terms of minimal farm gaps and overlaps, should be high so that villagers accept their authenticity.

![Figure 6: Effectiveness of map production process](image)
2.3. Software administration:

Following software administration activities of the PGIS solution must be relatively easy so that they can be undertaken with minimal support from remotely located experts:

i. Installation
ii. Remote maintenance
iii. Client/server data synchronization

![A Framework for Iterative Development and Evaluation of GIS](image)

Figure 7: Software administration

3. Conclusions:

A framework for iterative development and evaluation of PGIS solutions for empowering rural communities is described. Criteria for evaluating their ease-of-use, effectiveness and software administration for map production and map utilization activities have been described in detail.

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References