INFORMATIONAL DEFICITS: WOMEN FARMERS IN INDIA ARE PARTICULARLY VULNERABLE TO CLIMATE CHANGE

APPLIED POLICY PROJECT

CLIENT: SATTVA CONSULTING

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DISCLAIMER

The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, or by any other agency.

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EXECUTIVE SUMMARY

Climate change poses immediate and long-term threats for India, its exposure to negative climate effects among the highest in the world. Already, 80% of the Indian population lives in districts highly vulnerable to extreme weather events such as floods, droughts, and cyclones; and by the end of the twenty-first century, global temperatures are expected to rise by 3.5°C (Wadhawan & Abhinash, 2021).

Under these climatic pressures, agriculture becomes an increasingly knowledge-intensive undertaking (Mittal, 2020). When asked about critical needs, farmers often specify that access to the "right information at the right time" is one of the most sought after need (Umadikar et al., 2014).

With 84% of rural women dependent on agriculture for their livelihood, climate change presents a critical risk to their health and productivity. However, women farmers in India are among the least informed segment of the population. Across dimensions of agricultural extension services, the internet, mobile and smart phone, they do not enjoy the same access to information as men do.

Given this information deficit, I explore a critical tool has emerged in the literature over the past two decades that can provide relevant agricultural and climatic information to empower women: **Information Communication Technologies (ICTs).**

Based on this review, I identify and propose three ICT interventions:

1. Mobile Phones
    - providing mobile phones through which text and voice messages can deliver information
2. Village Information Centers (VICs)
    - establishing an internet kiosk in a village center where women can access information
3. Radio Campaigns
    - forming listening groups in which radio broadcasts disseminate relevant information

To assess alternatives, I evaluate each on the following criteria: cost-effectiveness, cost-per-farmer, tech. capabilities, communal learning, and scalability. Analyses indicate that **VICs**, the "**e-Choupal**," in particular, presents wide-ranging advantages across almost every criterion.

ITC Limited currently operates 6,500 e-Choupals across ten Indian states, its services reaching over four million farmers (The Better India, 2018). The private sector initiative has been the focus of numerous studies affirming its usefulness to farmers (Babu et al., 2015; Bowonder et al., 2002; Senthilkumar et al., 2013; Verma, 2016).

With the ability to scale across different regions of India, there is great promise in adapting the e-Choupal to the female farmer who has historically remained on the sidelines of accessing critical information.

Intro

This document explores the informational deficit women farmers face in India. It first defines a problem statement before exploring the scale and scope, causes, and consequences of the problem. It then reviews the literature on information communication technologies (ICTs) and proposes alternatives stemming from this evidence. Next, it identifies criteria that solutions will be evaluated against. Subsequently, the document analyzes how each alternative performs under the criteria set. Finally, it presents these findings in an outcomes matrix and provides a recommendation of one policy alternative and discusses the tradeoffs and implementation challenges involved.

Problem Statement

Women farmers in India do not have the same access to information as men across dimensions of agricultural extension services, the internet, mobile and smart phone. This deficit leaves rural women, 84% of whom depend on agriculture for their livelihood, with weak adaptive capacities, unable to make proactive and informed choices in the short to medium term about how to adapt to disturbances, like climate change.

Client Overview

Sattva Consulting is an Indian development consulting firm focused on scalable solutions for social impact. Sattva partners with social organizations, foundations, corporations, and philanthropists to achieve their social impact goals, working across many different sectors, such as financial inclusion, healthcare, and agriculture. Previously, Sattva has undertaken projects focusing on women, agriculture, and climate change. This project lies at the intersection of all three dimensions. The effects of climate change are already being felt in the agricultural sector, especially by rural women, and addressing key informational deficits now will enable future adaptation to increasing climatic pressures. Sattva is a thought leader in Indian development and its reports and analyses carry prominent influence among a wide range of actors in the sphere. This project is tailored neither to a specific partner nor policy stakeholder, but rather, intended for publication as a report under their "Sattva Knowledge Institute" for the entire ecosystem. As such, it will explore the lens of gender information, examining and proposing interventions for rural women farmers that can be adapted across various rural contexts and promoted by a range of stakeholders.

BACKGROUND

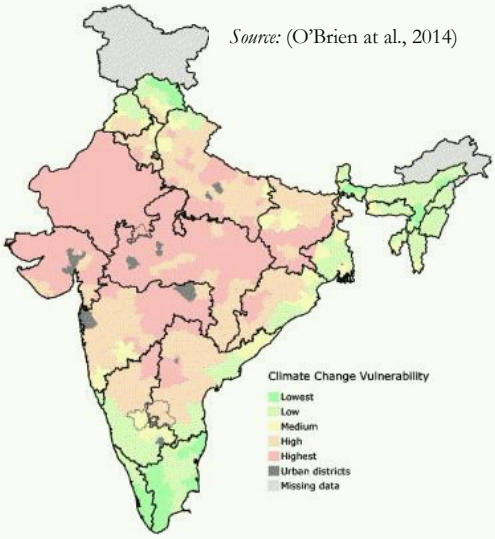
CLIMATE CHANGE

During the period from 1901-2018, India's average temperature rose by 0.7°C, warming largely due to human-induced climate change with the emission of greenhouse gases (Aggarwal, 2008). If current greenhouse gas emission rates are sustained, global temperatures are expected to rise by almost 3.5°C, perhaps more, by the end of the twenty-first century (Krishnan et al., 2020). Further, more than 80 percent of India's population lives in districts highly vulnerable to floods, droughts, and cyclones (Mohanty and Wadhawan, 2021; Krishnan et al., 2020).

The majority of studies predict that the effects of climate change are significant for Indian agriculture: crop production could drop by 10-40% by 2080-2100 if global warming continues unabated (Aggarwal, 2008; IPCC, 2007; Parry et al., 2004). Further, rice and wheat, two staples of Indian agriculture, are expected to experience a 6-10 percent decrease in yields before the end of this decade, by 2030 (Goswami, 2017). Already, the frequency and intensity of extreme weather events are intensifying freshwater shortages, increasing pest and disease outbreaks, causing reduced harvests and the displacement of crops due to the loss of biodiversity (FAO, 2017).

FIGURE A. CLIMATE CHANGE VULNERABILITY

Source: (O'Brien at al., 2014)



INDIAN AGRICULTURE

The Indian agricultural sector is particularly vulnerable to climate change as more than half its 1.4 billion population relies directly on climate sensitive sectors such as agriculture, forestry, and fisheries, for subsistence and livelihood (Rossman & Singh, 2021). According to World Bank Data, India's agriculture sector is the largest in the country's economy, representing a staggering 42% of its workforce, second only to China in size and output (*Employment in Agriculture - India*, 2021).

Further, dependence on agriculture is particularly pronounced for women in the rural setting. Almost 84 percent of rural women are engaged in agriculture and depend on it for their livelihood and nearly 75 percent of the full-time workers on Indian farms are women (Kristjanson et al., 2015). Yet, the Indian agricultural system poses challenges specific to rural women farmers. The term *rural women farmer* describes: "women living in under-served rural areas and working in agricultural production facing obstacles of poverty, informal employment, and gender inequality" (Berghoff, 2021).

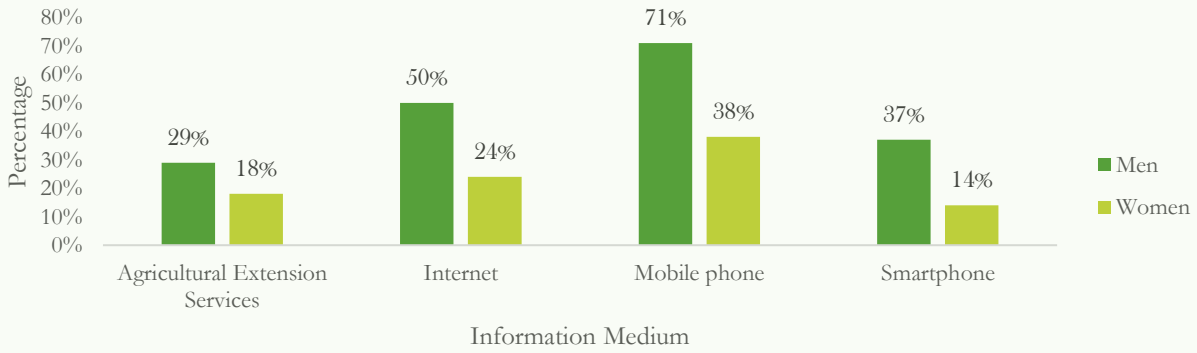
GENDER

Due to several gender gaps, studies have found that rural women farmers have different adaptive capacities to combat the effects of climate change compared to men (Aryal et al., 2014; Chatterjee, 2021; Kristjanson et al., 2015). Adaptive capacity can be defined as the ability to make proactive and informed choices in the short to medium term about how to adapt to disturbances (Silici et al., 2021). Adaptive capacity is of great significance for rural women farmers as they are highly vulnerable to the risks of variability in climactic conditions.

While many factors affect the ability of rural women farmers to build adaptive capacities, key to this is information. As agriculture becomes "increasingly knowledge-intensive" due to climatic pressures and the availability of new farming methods and technologies, the more informed farmer is the one who is more likely to make better decisions with limited resources (Mittal, 2020). When asked about critical needs, farmers often specify that access to the "right information at the right time" is one of the most sought after need (Umadikar et al., 2014).

INFORMATION DEFICITS: SCALE AND SCOPE

FIGURE B. INFORMATION ASYMMETRY



In recent years, improvements in technology have led to cheaper internet, data and mobile phone costs. Such advances present opportunities for the dissemination of agricultural and climate information, but while the Indian rural landscape as a whole has progressed, women still lag far behind men in key informational deficits.

Across dimensions of mobile phone, smart phone, and internet access, women in India do not enjoy the same level of access as men. In fact, an international report on the mobile gender gap found the biggest disparity among all participating countries on mobile phone usage in India, where men almost double women on usage (GSMA, 2020). A study from the Harvard Kennedy School estimates that 71 percent of men use mobile phones, compared to only 38 percent for women (Shah, 2018). This gender divide extends to smartphone ownership too with only 14 percent of women owning smartphone

while the same figure is 37 percent for men (GSMA, 2020). Finally, among active internet users, the ratio of male to female users is 60:40 (Jha, 2022).

This gender disparity in information access comes against the backdrop of a burgeoning information era. Data costs have decreased by 95% since 2013 and high-quality low-cost smart phones are rising in availability, too, with some manufacturers having introduced entry-level models costing less than $80 starting in 2016 (Sampathkumar, 2021). These technological improvements are complemented also by Indian government initiatives aimed around telecommunication infrastructure. The government, under the 2015 'Digital India' program, launched several policies and applications around digital infrastructure, e-Governance services and society's digital empowerment (ICEA, 2020). In a drastic shift from the past decade, rural environments and villages are well connected with almost complete 3G network coverage and GPRS (General Packet Radio Service) networks that enable voice connectivity (Berghoff, 2021).

Rural India has shown a willingness to adopt technology at a fast pace and much anticipated is the continued growth of internet and information access in rural settings, presenting an opportunity for rural women farmers. In 2018, the availability of smartphones in rural India was 36.5 percent, which surged to 67.6 percent in 2021 (Iftikhar, 2021). Further, the amount of internet users is expected to grow by 200 million in rural India by 2025 as the urban space seems to have reached a plateau. Internet and information access is becoming both a reality and necessity for livelihoods in rural India and the gender divide poses a threat of perpetuating inequalities (Wajcman et al., 2020).

The process of providing women with access to information has been critically slow, however, to the detriment of rural women farmers. Data from 2021 shows almost half of rural men use the internet, while less than a quarter of women do (Basuroy, 2021). This deficit is staggering, and although the internet is just one source of information, multiple studies find rural women farmers have much less access to key information essential to agricultural operations, such as the short and long term weather forecasts, compared to men (Edmunds et al., 2013; Kristjanson et al., 2015). Further, when presented with climate adaptation options, Indian women typically report they did not either have knowledge of different methods, or see a need to make changes at all, highlighting the critical informational deficits facing women in the sector (Aryal et al., 2014). This divide has ultimately limited the ability of women to build adaptive capacities in light of climate change.

CAUSES

Various causes leave rural women farmers without access to sufficient information to adapt to the effects of climate change, including different gender biases and shortcomings of the information ecosystem itself. These factors ultimately result in inequitable access to key informational resources for women, leaving them with limited agency to adapt to the burdens of climate change.

GENDER BIASES

CULTURAL NORMS

Cultural norms entrench women as secondary to men in the Indian agriculture sector limiting their ability to enjoy the same access to information that men do. Aryal et al. (2014) explores how farmers and other agricultural actors in India conceptualize women farmers. In their work, the authors convey how language itself holds the concept of the farmer as male, expressed in the Hindi word *Kisan*. These cultural and idiomatic notions create a distinct view of women in agriculture as paid laborers - not considered to be farmers, "despite their highly visible participation in productive and labor intensive activities" (Aryal et al., 2014). These norms work to render women's work as invisible and therefore unacknowledged, according to Aryan et al (2014). This cultural conception manifests also in financial losses for women farmers: for the same agricultural work, men get paid a premium of 22 percent more than women (Pandey, 2018). Finally, and perhaps most relevant, in some Indian villages, the notion of women using "men's technology" poses concerns regarding morality and social order that prohibits women from using mobile phones (Jeffrey and Doron, 2013; Lewis, 2016). Cultural norms impose frictions for women attempting to access information that men do not experience.

HISTORICAL NORMS

In addition to these cultural norms, longstanding legal customs too have limited the ability of women to access informational resources. The Hindu Succession Act of 1956 that mandated sole rights over parental property and land go to male offspring was in practice until 2005, when the Act was amended to provide equal inheritance rights to women (Velayudhan, 2009). This history established widespread patriarchal norms that have deterred women from acquiring land (Agarwal, 2003). The law's amending has not led to equal, or significant, women's land ownership: 55 percent of India's female workforce is employed in agriculture, yet less than 14 percent of landholdings are operated by women (Chatterjee, 2021). This deficit in formal land titles restricts women from accessing public benefits and subsidies, furthering the gender gap in not just land ownership, but also in access and control over critical assets such as labor, credit, and information needed for agricultural production (Majmuder and Shah, 2017).

Extension Services Bias

These cultural and historical norms function together to bias agricultural extension services that often fail to provide women with access to informational resources. Agricultural extension services enable farmers to improve their productivity by providing information, advice, inputs and other support services (Zhou & Babu, 2015). In the rural setting and under climactic pressures, the role of extension services becomes significant as information is critical in helping resource-poor, remote farmers increase their decision making capacity (Mittal, 2020). However, Indian agricultural extension services demonstrate a stark and well-documented gender bias of traditional, male-dominated access to information, participation, implementation, and innovation (Mittal and Mehar, 2015; Bello et.al., 2017; Saghir et al., 2013; FAO, 2011; 2015; MunMehar et al., 2016). Consultation with extension agents to collect information on farm technology are predominantly the activities of male farmers as cultural and social barriers deter women farmers from interacting with male extension agents (Aryal et al., 2014; Mittal, 2016). Extension services often fail to acknowledge and ameliorate underlying gender inequalities as they provide critical services, often burdened by staffing and funding shortages (Farnworth and Colverson, 2014; Mittal, 2020). The conception of man as farmer removes women from key interactions between advisory services and famers, limiting women's access to critical information for the agricultural process (Demetriades and Esplen, 2008).

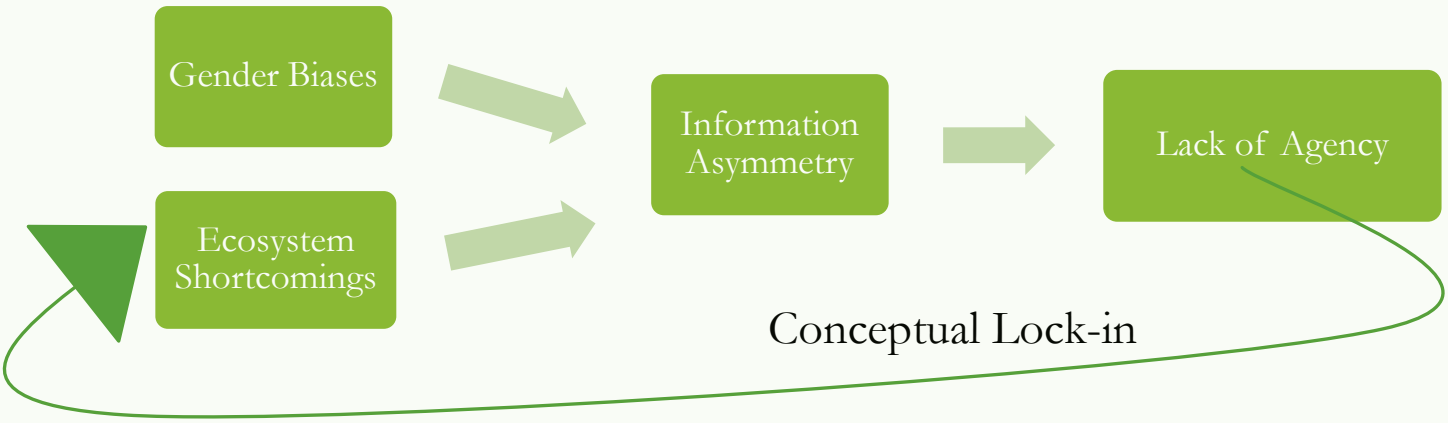
Information Ecosystem Shortcomings

Characteristics of the information ecosystem itself also limit the provision of information to the agricultural sector, and subsequently to women farmers. Krishna and Naik (2020) in particular outline several factors that contribute to the limited development of information access in India. First, the study contends, focus on agriculture has shifted from information and research to providing farmers with subsidies and inputs. Resources are now increasingly being focused on raising the incomes of rural farmers through other means than their agricultural productivity. Second, this shift away from information has been precipitated by a severe decline in funds for agricultural research and its dissemination, the study finds. As large multinationals deal in agricultural technologies, funds devoted by the state to information delivery in agriculture remain low. Third, the information ecosystem faces a challenge inherent in its nature: it is difficult to prove the effect of information delivery on material results in agriculture, since other environmental factors make it challenging to isolate the impact of information. Other initiatives, such as irrigation, can be much easier to trace to outcomes like harvest and income. Fourth, information delivery is rather complex to implement because Indian farmers fall into a large spectrum in their resources, skills, and ability to understand information, the study details. Information needs to be tailored in their content and method of dissemination to specific farmer populations in order to facilitate learning. Along with gender biases in the Indian agrarian system, the information ecosystem itself further exacerbates the ability of women to access information(Krishna & Naik, 2020).

Limited Agency

These factors each work in tandem to further accelerate a key dynamic that entrenches women in a position of vulnerability in the agriculture sector: conceptual-lock in, illustrated in Figure A. This concept contends that, due to gender biases and ecosystem shortcomings, key information becomes habitually reserved for males, creating a self-fulfilling cycle in which men further and further gain specialized knowledge, while women are assumed to be secondary in decision making processes (Aryal et al., 2014). This is emblematic of the Indian context, as Aryal et al. (2014) explains, the male's decision is regularly considered as final in the household for adoption of new technologies or practices. With women unable to access information on their own, these decisions are often made without consideration of the different and labor intensive work typical of women that faces unique climate risks (Chatterjee, 2021). This information asymmetry leads to an entrenching cycle, in which patriarchal attitudes prevail not only among men, but also among women, as they must rely on men while making decisions related to climate change adaption (Aryal et al., 2014). Conceptual lock-in prevents women from gaining access to critical information and maximizing their decision-making capacity.

Figure C. Conceptual Lock-in

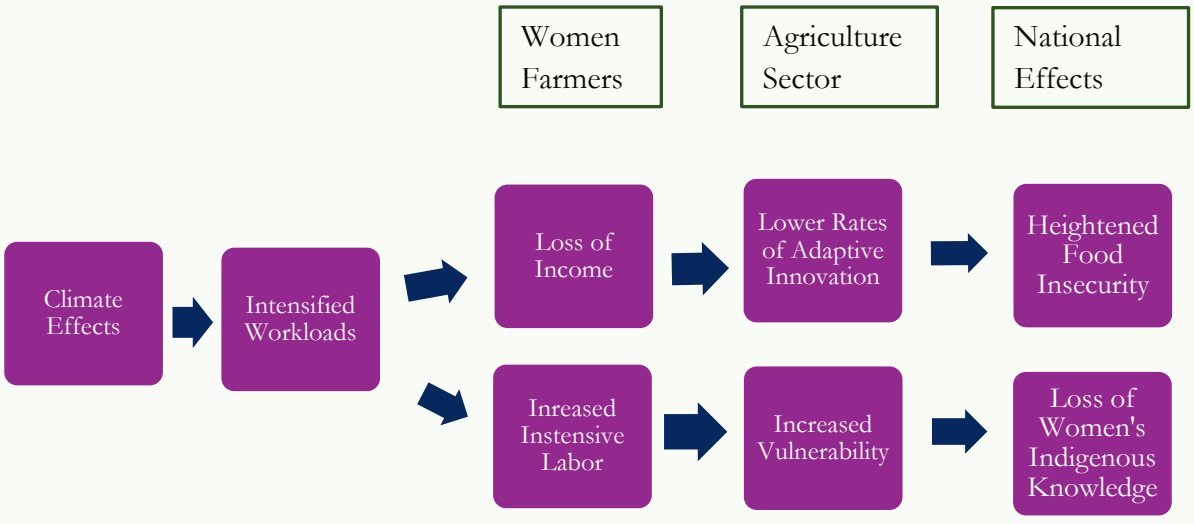


Consequences

The consequences for women farmers, the agricultural sector, and national landscape of women's lack of agency in combatting climate change are critical and wide-ranging, exhibited in Figure B. Case studies show that environmental stress in farming systems often translate to the intensification of women's workloads (Bridge, 2008; Awumbila & Momsen, 1995; Agwu & Okhimamwe, 2009). This heightened workload causes a greater need to perform labor-intensive tasks and a loss of income as they cannot spend their time on more economically productive activities (Ashby et al., 2012). Women farmers are often already the victims of poor financial security, and the effects of climate change put their safety and well-being at risk, increasing their vulnerability (Siwal & Chaudhary, 2022). With these tightened financial and labor constraints, women are unable to shift practices according to climate needs, and have lower rates of adaptive innovation compared to men (Ashby et al., 2012).

These agricultural sector dynamics have significant implications for the national landscape. Everyone, not just women, are in a vulnerable position with heightened food insecurity. According to FAO (2011), not addressing the gender deficits in agriculture could cause losing out on 2.5 to 4 percent of growth in agricultural output and the potential to bring an estimated 100 million people out of poverty. Further, as women experience more vulnerability, women's indigenous knowledge, such as of important food and medicinal plants, is at risk of losing its viability, a critical loss for the entire population and future generations (Ashby et al., 2012).

Figure D. Consequences of Climate Change



The Potential of Information Access

Information access has immense potential to bolster the adaptive capacities of rural women farmers. Women farmers have become more aware of the value of agricultural and weather information delivered to them, feeling empowered with this information as they become more aware of new practices and climate-smart technologies that can help them address the effects of climate change (Ashby et al., 2012). Especially as agriculture becomes more knowledge-intensive within the context of climate change and cropping patterns, accessing real-time information becomes critically important to prevent the gender disparity in agriculture from worsening (FAO, 2017). The delivery of this agriculture-related information has increased women farmer productivity via "informed decision making on crop choice, seed varieties, inputs, agronomic practices, and plant protection; reduction in production costs through the adoption of better/quality inputs and technologies and better management practices; and improved incomes resulting from reduced costs and better price realization for the produce" (Mittal, 2020). Information access via new technologies for women farmers can also reduce the gender bias in agricultural extension services to facilitate market transparency and improve logistics (Mittal and Tripathi, 2009; Mittal et al., 2010; WDR, 2016). Ultimately, female farmers reveal they highly value information and the awareness it affords them on issues related to climate change and climate-smart practices.

Information access, although just one of the many issues that afflict rural women farmers in the Indian agricultural sector, presents great potential. On its own, it will not alleviate the myriad challenges faced by rural women. However, information services that can overcome existing gender barriers are a significant factor and a first step that should be prioritized, among many, to increase capabilities and decrease vulnerabilities posed by climate change. Further, with improvements in technology reducing data and internet costs, information interventions are situated within a promising environment in the Indian context. Following suit, the private, public, and government sectors have all emerged as key players in delivering agricultural information in recent years. Information interventions can be generalizable across different rural regions in India and implemented by various stakeholders, giving cause for its focus and literature review in this report.

EVIDENCE

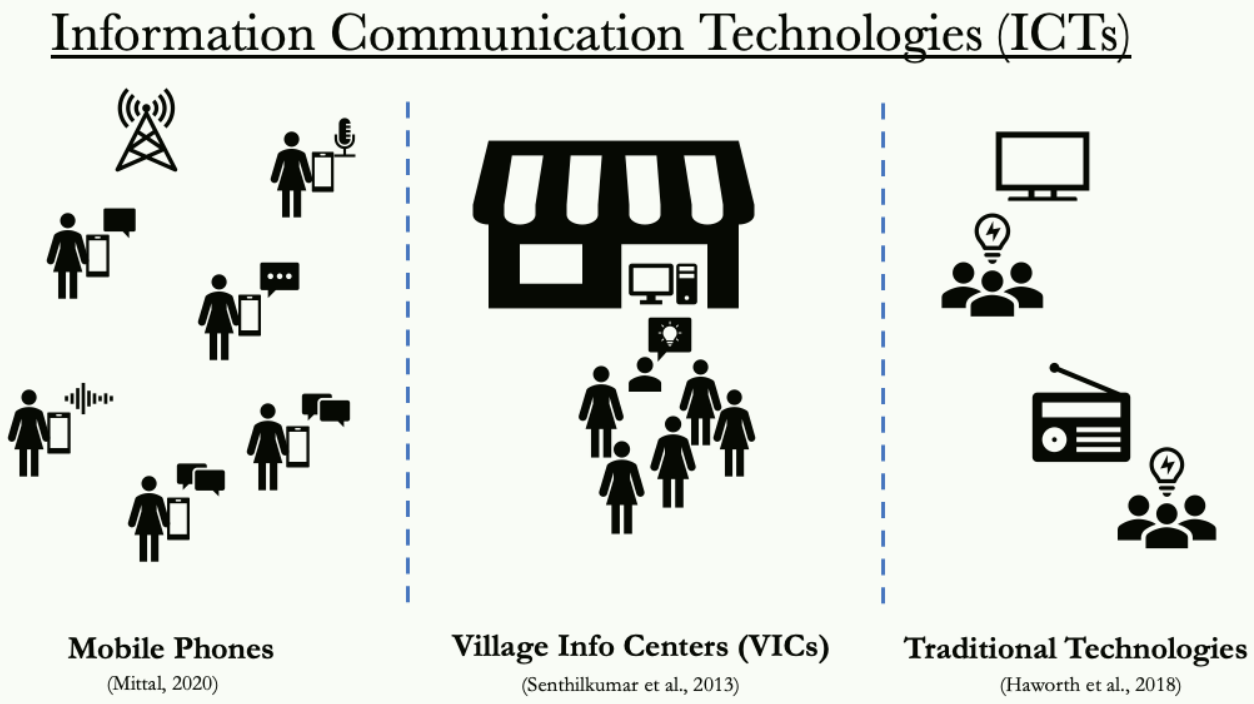
INFORMATION COMMUNICATION TECHNOLOGIES (ICTS)

There is a wide body of research that has studied the capabilities and effectiveness of information interventions to improve the abilities of farmers in various developing contexts, including India. Specifically, an important tool has emerged in the literature over the past two decades that can provide relevant agricultural and climatic information to empower women to adopt practices based on climatic pressures: Information Communication Technologies, or ICTs (Chanana-Nag & Aggarwal, 2020).

However, the gender perspective on climate information has "not been extensively studied, and the literature highlights the necessity of creating gender-responsive climate services" (Mittal, 2020). Further, Haworth (2018) proposes that a detailed analysis of the varying technological approaches available to specifically determine which most effectively provide agricultural information to women farmers would be highly valuable.

Below I highlight evidence stemming from three main forms of ICTs that can address the information asymmetry between women and men in Indian agriculture and improve women's adaptive capacities in the face of climate change: mobile phones, village information centers, and traditional forms of communication.

FIGURE E. MODALITIES OF ICT INTERVENTIONS



Mobile Phones

Advancements in mobile phone capabilities and technologies led to an outgrowth of research studies investigating the use of the mobile phone as a modern ICT in the past two decades. Initial studies focused largely on the potential of mobile phones in reducing the knowledge gap between large and small farmers; however, a new and growing body of research within the past ten years shows that access to mobile phone-enabled delivery mechanisms can increase the accessibility of agricultural and geographic information specifically for women farmers, with evidence from India and other developing contexts like Pakistan and Bangladesh (Haworth et al., 2018; Islam & Slack, 2016; Mittal, 2016; Saghir et al., 2013). These studies vary in the precise mobile phone technology they employ, whether it be a mobile application, SMS messaging, web-based portal or others. Their results, however, are consistent across technologies and geographies: mobile phones reduce the barriers of information asymmetry between rural male and female farmers.

The most relevant Indian study, Mittal (2016), directly investigates the gender dimensions of climate information by analyzing the effects of a mobile phone technology given to and utilized by rural women farmers. The study provides strong evidence to the efficacy of mobile phone-enabled delivery mechanisms for rural women farmers. Undertaken in select villages in two Indian states, Haryana and Bihar, the intervention sent voice and text (SMS) messages in a local language to the mobile phones of over one thousand farmers. These twice-a-week messages included information on weather forecasts, pests, seed varieties, and about climate change, its effects on agriculture, and climate-smart technologies. The listening behavior of women and questionnaire data provided a clear picture across all villages: "women farmers value these services, show interest in learning about new climate smart technologies, and feel empowered with the information delivered to them." Further, the information women listened to helped create a more efficient use of inputs and more climate sensitive decision making (Mittal, 2016).

Studies in other developing countries in which women also face a gender bias within the farming landscape show similar results supporting the mobile phone as an informational tool. Saghir et al. (2019) compares different forms of ICTs across almost 30 farming villages in Pakistan; and Islam & Slack (2016) examines the impact of mobile phone use by women across three rural villages in Bangladesh. The former demonstrates that women rank the mobile phone, a modern ICT, higher than traditional ICTs such as print, radio, and telephone, in both the availability and utility of the information it provides, and the latter finds that women feel "independent and empowered" with access to a mobile phone. Both studies notably find that women feel their development has accelerated and will continue to accelerate using a mobile phone (Islam & Slack, 2016; Saghir et al., 2013).

Mobile phones present distinct advantages in improving information accessibility for women farmers, but also have critical limitations within the Indian context. The data requirements and costs of mobile phones are comparatively low and allow for highly frequent and tailored data compared to other technologies; however, their use can only be considered in tandem with the availability and capacity of necessary information and telecommunications infrastructure, such as electricity and high-speed

internet access (Haworth et al., 2018). On top of technological and cost barriers, low literacy levels too hamper the use of the mobile phone by small-scale women farmers (Mittal, 2016). Strengthening not only access, but comprehension of information for women is critical and review of several ICT initiatives emphasizes the of importance of low-tech, user-friendly technological platforms (Haworth et al., 2018). If mobile phone technologies can be harnessed effectively, they can bolster women's resilience and capacity to adapt to the effects of climate change.

Village Information Centers (VICs)

Village Information Centers (VICs) are another form of ICT that has been studied extensively in India and other developing contexts. VICs can be described as an internet kiosk or tele-center that provides access to real-time information especially relevant to farmers, such as local weather, commodity prices, farming practices, and climate risk management, in a site within walking or tractorable distance of target farmers (Bhatnegar, 2008). A wide body of research in India provides robust evidence to the ability of VICs in providing critical agricultural and geographic information to farmers (Adhiguru & Devi, 2012; Babu et al., 2015; Bowonder et al., 2002; Senthilkumar et al., 2013; Verma, 2016). Although these studies have not directly focused on the gender perspective, they have implications for potential ICT interventions that can reduce the information asymmetry between men and women farmers, supported by a study from the Nigerian context examining the ability of VICs to empower women farmers (Obayelu & Ogunlade, 2006).

Across several Indian studies, two private sector VIC initiatives are examined: the "e-Choupal" and "I-kisan." Similar in nature, they provide farmers with agricultural information via kiosks within a village. With the former having 6,500 kiosks across ten states and the latter with 21 across two, the studies' findings are consistent across a wide range of geographies and present strong evidence for generalizability. Their qualitative results indicate that VICs enable the dissemination of information in a "user friendly form, easy to access, and cost-effective" method, that can be scaled, replicated, and sustained with its private business model (Babu et al., 2015; Bowonder et al., 2002). Further, quantitative data from the studies show VIC usage contributes to knowledge and possibly income gain, their use positively associated with income at a statistically significant level, and reduce typical informational and transaction costs (Senthilkumar et al., 2013; Verma, 2016).

The gender-dimension of VICs is explored in Nigeria by Obayelu & Ogunlade (2006), that along with studies done in India, present potential for VICs in bridging the information gap between male and female farmers. Examining a host of Nigerian ICT initiatives, Obayelu & Ogunlade (2006) finds that access to low cost ICT tele-centers for women enhances their access to accurate and reliable information leading to their empowerment and self-determination. Challenges, however, certainly exist in adapting VICs to a gender-specific aim. Particular attention must be focused towards ensuring

women have access to and utilize these VICs (Mariscal et al., 2019). To ensure these spaces take into consideration the needs and preferences of women, women farmers should be able to participate at the formulation and implementation stage of such interventions (Obayelu & Ogunlade, 2006). VICs present great possibility also in their promotion of community and shared learning to mitigate climatic risks (Babu et al., 2015). With gender-conscious design, VICs have the potential to provide shared community spaces that can break information barriers currently harming women agriculture workers in India.

Traditional Forms

Outside of mobile phones and VICs, more traditional and primitive forms of information communication, such as radio, loudspeakers and print media have been utilized in ICT initiatives. Many of these initiatives have been components of longstanding agricultural campaigns, some from more than 50 years ago, but only offer anecdotal evidence to their efficacy. Recent studies in the academic literature, however, have analyzed these traditional ICTs in developing contexts and present evidence of another tool that can be used to increase information access for women farmers.

Radio interventions have been the focus of academic studies which have found the low-tech ICT to increase information access, although without a particular focus on gender (Haworth et al., 2018; Hudson et al., 2017; Nazari & Hasbullah, 2010). From contexts in six African countries, Pakistan, and India, the studies' analysis of radio campaigns, some validating their results with knowledge tests, show causal evidence that as radio listenership increases, awareness of important agricultural information does as well, along with an increased adoption of new agricultural techniques and practices at times. The authors find radio campaigns to be highly feasible with their limited technology requirements and cheap costs compared to other ICTs. Furthermore, the studies reveal that participatory approaches with radio interventions can impact listenership, knowledge and initial adoption of new behaviors (Haworth et al., 2018; Hudson et al., 2017). Such participatory approaches include creating groups in which farmers listen to regularly scheduled radio programming and subsequently discuss its content, potential new innovations, and practical advice for the adoption of new practices (Hudson et al., 2017). These participatory elements offer benefits other top-down ICT approaches do not, in addition to community perceptions of radio-disseminated information as high quality, trustworthy, and locally-relevant (Haworth et al., 2018).

Takeaways

A vast body of literature highlights the ability of different forms of ICTs to combat the information asymmetry present between male and female farmers in India. The broad categories of these forms are mobile phones, VICs, and traditional communication technologies. There is great deal of evidence to each of their efficacy, although not all of it examined through the lens of gender. At its basis, these ICTs can harness the decreasing costs of data and information and provide highly relevant agricultural information to rural women farmers. Mobile phones emphasize individual approaches that can be highly tailored to the specific farmer. VICs allow for truly low-cost tele-centers that provide opportunity for the private sector to provide informational services. Finally, more traditional technologies can allow for participatory approaches that encourage collaboration among women farmers. It is clear ICTs have immense potential to increase information access for rural women farmers.

The literature emphasizes that any solution must keep in mind the constrained resources and context of rural India in its agricultural sector. Serious technological, financial, and cultural factors all pose challenges to any proposed intervention targeting women. Further, in an environment of low literacy rates and digital capabilities, any information provided must be accessible to women if it is to aid their ability to address the pressures to climate change. Overall, socio-cultural norms limit women's access to climate information, and ICTs can help break this barrier (Mittal, 2020).

Confronting specific tradeoffs between different ICT interventions and their most successful modalities can provide a clearer picture as to the potential alternatives to consider that can increase informational access and improve the adaptive capacities of women farmers to combat the effects of climate change. In the next section, I propose three alternatives following suit from the literature. Discussion of the cost of such interventions, the precise technologies they employ, the amount of women farmers they can reach, the stakeholders they could be implemented by, and the agricultural and climate information they can disseminate is a critical next step surfaced in the following alternatives and criteria section.

Alternatives & Criteria

Proposed Alternatives

The proposed alternatives each target 500 women and are designed as proof-of-concept initiatives over a three year duration. While the scope of this problem exists at a national level and on a long-term basis, solutions must be administered and adapted to the local environment and its needs. The following alternatives, if implemented, will add value to the current literature on ICTs by: (a.) adapting interventions towards women, and (b.) providing valuable implementation lessons for both local stakeholders and national actors to glean a roadmap for scaling commensurate policies and programs.

The proposed alternatives, defined in greater detail in the subsequent "Findings" portion of the report, are as follows:

1.) Mobile Phones

- providing mobile phones through which text and voice messages can deliver information

2.) Village Information Centers (VICs)

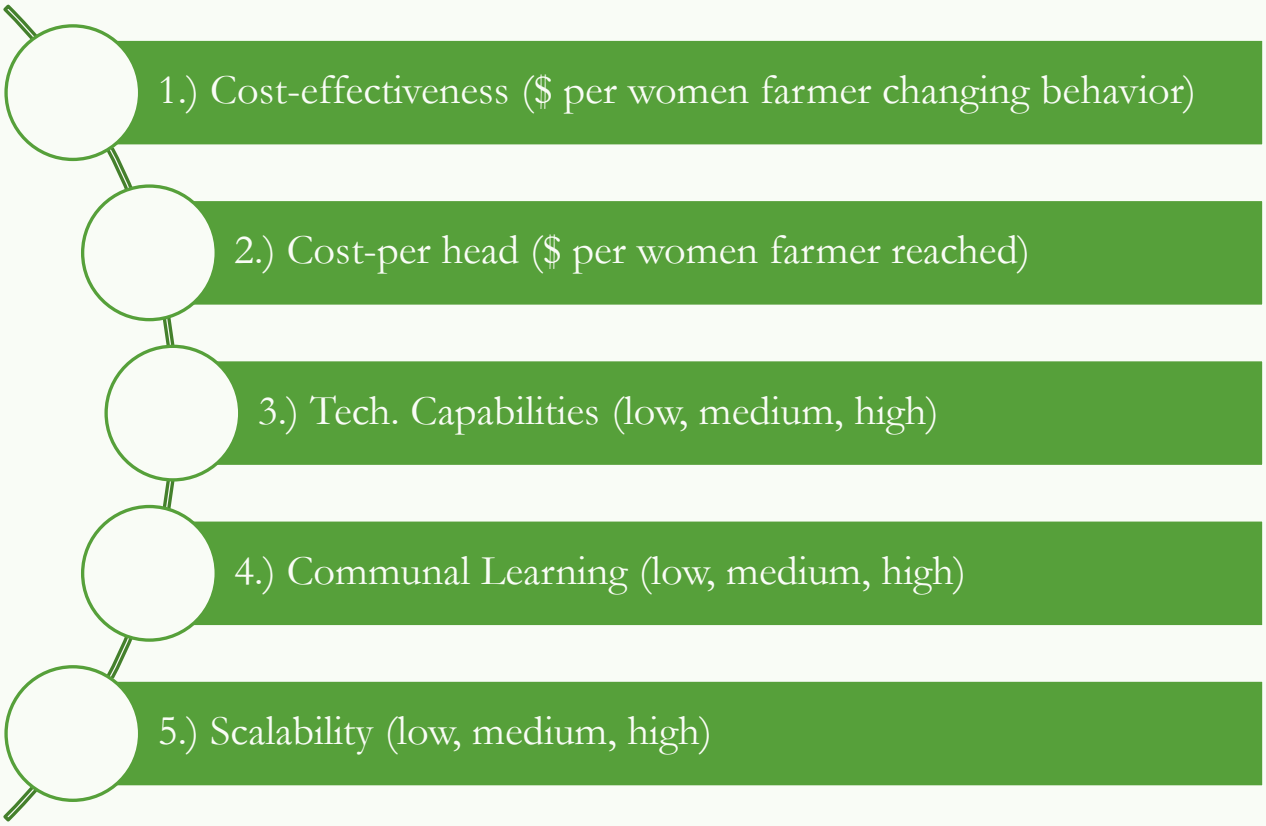
- establishing an internet kiosk in a village center where women can access information

3.) Radio Campaigns

- forming listening groups in which radio broadcasts disseminate relevant information

Evaluative Criteria

To assess the alternatives, five distinct evaluative criteria are set. The rationale for each criterion and how they are operationalized and measured in this report can be found in **Appendix A**. The criteria are as follows:



FINDINGS

ALTERNATIVE 1.) MOBILE PHONES

This alternative will provide women farmers with mobile phones through which agricultural and climate information can be disseminated. This proposed intervention takes advantage of a burgeoning information era in which technology and data costs have decreased immensely and evidence from numerous studies demonstrate the efficacy of mobile-phone enabled information delivery mechanisms in empowering women farmers (Haworth et al., 2018; Islam & Slack, 2016; Mittal, 2016).

Specifically, this alternative will provide 500 mobile phones to women farmers within a geographic locale comprising of about 10 villages. The selected women will receive twice a week messages in both text (SMS) and voice format in the local language including information on weather forecasts, pests, seed varieties, and about climate change, its effects on agriculture, and climate-smart technologies. This program can be implemented by an agricultural NGO that operates in the region and be financed through government spending or foundation funds. NGO personnel will be responsible for the provision of mobile phones and initial training for women farmers on their use and the program's outlook, along with the content creation for the messages. The NGO, with its agricultural know-how and past experience, can study the local environment and generate suitable content prior to program implementation

COST-EFFECTIVENESS

The main categories of cost for this intervention break down along the lines of: hardware, the cost of a mobile phone, SIM card and charger ($15,000); software, the cost of a phone service plan ($12,000 per year); and personnel, the cost of an experienced NGO project manager with a background in agriculture who can create content for mobile messages, operate the phone help line and perform administrative duties ($18,000 per year). Its total cost falls at just over $100,000 for three years and is the most expensive of the proposed alternatives (see Appendix B.).

In terms of effectiveness, the alternative is adapted closely to the intervention performed in Mittal (2016) and utilizes its metric for the share of "women farmers who were engaged in farming reported having taken action on the information they received" – 83 percent. In adapting this figure, the following assumptions are made: the mobile phones alternative I propose is closely akin to Mittal (2016), so we can assume its effects on behavior take-up are similar across different geographies and farmer populations. The intervention in Mittal (2016) sent voice and text messages in a local language to the mobile phones of over one thousand farmers in the states of Haryana and Bihar.

Combining this data, the mobile phones alternative cost-effectiveness is about **$250 per woman farmer taking up new behavior and slightly over $200 in cost per woman farmer reached.**

TECH. CAPABILITIES

Mobile phones present distinct advantages in improving information accessibility for women farmers, but also face critical limitations within the Indian context. Under the listed alternative, women will receive twice a week messages in both text (SMS) and voice format in the local language. Enabling comprehension of information is equally as important as dissemination, and the non-written medium is key to the Indian rural landscape in which about one-third of women are illiterate (Kanwal, 2021). However, an additional form of literacy poses an obstacle to this alternative: technological literacy, referring to one's ability to "use, manage, evaluate, and understand technology" (ITEA, 2012). Literacy deficits may work to further technological deficits in this instance, using devices such as mobile phones, and hence limit the ICTs ease of use (Mittal, 2020). These risks, however, can be mitigated through a training program on mobile phone usage at the start of the intervention.

While nuance exists as to the accessibility of the mobile phone for women farmers, the ability of the user to tailor the information they receive to their needs is both clear and of great value. Under this alternative, farmers are able to call a helpline to ask questions, similar to the intervention from Mittal (2016). This enables women to receive the information they need while at the same time contributing to the content of future messages by making them more locally relevant. Further, this interactive functionality promotes participant feedback and allows users to acquire information related to their individualized farming activities (Mittal, 2016). Evidence from Saghir et al. (2013) shows this tailorability critical: Women feel that mobile phones, a modern ICT, increase the availability and utility of information far more than traditional ICTs such as print, radio, and telephone, and hence prefer them over traditional ICTs. While obstacles of technological literacy present reason for slight caution, this alternative is ranked as **"high"** for its tech. capabilities.

COMMUNAL LEARNING

Mobile phones are designed to empower the individual and following suit, the mobile phone alternative can be characterized as individualistic, rather than communal. This alternative disseminates information via mobile phones, leading to its consumption being realized by each individual themselves. However, while consumption of this information is private, mobile phones do enable peer to peer communication. Women farmers can send messages to one another via their mobile phones, discussing information they received. Although, there is not a great deal of evidence as to this feature promoting knowledge gain or adoption of new behaviors (Haworth et al., 2018; Mittal, 2016). Without a formal space for or a participatory approach that involves women farmers in the alternative's design, this alternative ranks **"low"** on communal learning.

SCALABILITY

The mobile phones alternative does not present a very strong case for its scalability. The process of surveying a community, identifying women farmers, distributing phones and training them on their use is rather onerous and makes for a lengthy implementation process. Furthermore, an agricultural expert is required to manage the program for its duration and would require funding from a government/philanthropic source for quite an expensive intervention. For these reasons, this alternative is ranked **"low"** on scalability.

ALTERNATIVE 2.) VILLAGE INFORMATION CENTERS

This alternative will create a village information center dedicated to women farmers that provides access to real-time information especially relevant for agricultural activities. This alternative is based on the success of the "e-Choupal," a private-sector initiative with 6,500 internet kiosks across ten Indian states and considerable evidence on its usefulness to farmers (Babu et al., 2015; Bowonder et al., 2002; Senthilkumar et al., 2013; Verma, 2016).

Specifically, this alternative will establish an "e-Choupal" tele-center in a location with 10 villages in a 5 kilometer radius that can serve approximately 500 women farmers. This e-Choupal will be operated by a trained woman farmer, a *sanchalak*, who can provide users with information on market prices, local weather patterns, climate risk management and can also place orders for inputs like seeds and provide quotes for farmers' crops. ITC Limited has established these e-Choupals and provided information at no cost for farmers as it saves them procurement costs. ITC Ltd. currently runs many women empowerment programs that have focused on entrepreneurial skills, and it can now establish a woman-dedicated e-Choupal with its past expertise.

COST-EFFECTIVENESS

The main categories of cost for this intervention fall along the lines of: costs incurred by ITC Ltd. running the e-Choupal, the cost of set up and internet connectivity ($10,800) and commission paid to the Sanchalak ($6,000 per year); and costs incurred by the Sanchalak, operating costs for the e-Choupal ($260 per year) and labor ($1,100 per year). Its total cost is quite cheap relative to the other proposed alternatives and falls at just over $33,000 for three years (see Appendix B.).

This alternative is designed and costed as another one of ITC Ltd.'s *e-Choupals*, the subject of numerous academic studies (Babu et al., 2015; Madan et al., 2016; Senthilkumar et al., 2013). Madan et al. (2016) analyzes use behavior, finding that 86% percent of participants felt that the e-Choupal and the information it provided played a large role in enabling them to better analyze their own situation and act to solve their problems. In adapting this figure, the following assumptions are made: the Village Information Center alternative I propose is closely akin to the e-Choupal studied in Madan et al. (2016), so we can assume its effects on behavior take-up are similar across different geographies and farmer populations, and that the 86% from the study represents the share of users who engaged in a new behavior or practice. Madan et al. (2016) surveyed 300 e-Choupal users across three different regions in India.

Combining this data, the village information centers alternative cost-effectiveness is about **$80 per woman farmer taking up new behavior and just below $70 in cost per woman farmer reached.**

TECH. CAPABILITIES

The village information center alternative, harnessing the abilities of a trained woman farmer, or *sanchalak*, who uses an internet kiosk to provide information for farmers, presents key advantages under the tech. capabilities criterion. Acting as a middle man (woman), the sanchalak will be able to

translate user's asks for specific information, or general questions, into online queries that can provide helpful results and information. Thus, removing the barrier of technological literacy, and providing information in a personable manner, its information is greatly accessible (Verma, 2016). However, what must also be considered here is the physical distance between the farmer and this information center. While "e-Choupal" centers are typically located in a 5 kilometer radius of about 10 villages, this distance is still non-zero, unlike a mobile phone (Babu et al., 2015). The tailorability, however, of information under this alternative is undoubtedly a strong suit. As a part of the ITC Limited network, e-Choupal centers have access to a wide range of data on weather forecasts, market prices, and climate risk management practices that women can tailor their asks to. (Senthilkumar et al., 2013). This alternative is ranked as **"medium"** for its tech capabilities.

COMMUNAL LEARNING

Village information centers (VICs) as aptly named, are designed with the village and its people in mind. Under this specific alternative, women have the ability to ask for and acquire information in a centrally located kiosk. This, by definition and design, is a communal gathering space in which information can be consumed in a shared manner. Additionally, the operator, or *sanchalak*, provides the information, making the exact point of consumption a space in which women can ask clarifying questions about the information they are receiving to ensure comprehension. This collaborative setting positively impacts knowledge gain and adoption of new behaviors (Hudson et al., 2017; Mittal, 2020). Furthermore, this alternative sets out to involve the community, women farmers from the village, to be involved for input on the design and implementation of the VIC to encourage its use. Research shows participatory approaches like this will help bolster the VIC as a vibrant gathering space for the community (Haworth et al., 2018). For these reasons, this alternative is ranked **"high"** for its communal learning.

SCALABILITY

The VIC alternative is extremely well positioned in terms of its scalability. ITC Ltd. has a proven track record establishing e-Choupals – there are currently 6,100 centers across 10 Indian states (Zhou & Babu, 2015). With this know-how and expertise, the company can focus on piloting a woman-focused center first and then expanding to other locations after learning valuable lessons. Further, the alternative requires only the training of a farmer in the local community, and not an agricultural expert, given the features of the ITC web portal. Finally, as the centers help save ITC on procurement costs, the alternative would be funded by the firm itself and does not require government or non-profit funds. This alternative is ranked **"high" for its scalability.**

ALTERNATIVE 3.) RADIO CAMPAIGNS

This alternative will establish radio listening campaigns that disseminate locally relevant agricultural information to groups of women farmers. Radio remains as a commonly used medium in rural India and presents key ease of use and accessibility advantages as users can comprehend information through their local language, regardless of literacy (Haworth et al., 2018; Hudson et al., 2017).

Specifically, this alternative will identify 500 women in 10 neighboring villages, and create 50 listening groups comprising of 10 women farmers each. Each village will have 5 listening groups who meet on a weekly basis and receive a small financial incentive to listen to a series of radio programs broadcasted to this targeted farming population, providing information such as new farming practices suitable for the local context, weather patterns, and crop price information. This model will be based on the principles of "listen, discuss, act," in which the groups listen to the weekly radio broadcast, discuss its content and pros and cons of potential new practices, and provide practical advice to one another for adoption (Hudson et al., 2017). This program can be implemented by an agricultural NGO via government or foundation funding with experience performing field work in the locale. The NGO with their agricultural know-how and past experience, can study the local environment and generate suitable content prior to program implementation.

COST-EFFECTIVENESS

The main categories of cost for this intervention fall along the lines of: hardware, the cost of radio and batteries ($1,000); participation incentive, the cost of a small monetary reward equivalent to about half a day's farming earnings for attending listening groups ($4,000 per year); and personnel, the cost of an experienced NGO project manager with a background in agriculture who can create content for radio sessions and perform administrative duties ($18,000 per year). Its total cost is found to be $65,000 over three years (see Appendix B.).

This alternative is based on the success of radio campaigns performed in various developing contexts (Haworth et al., 2018; Hudson et al., 2017). Hudson et al. (2017) analyzes the behavior of households who partook in an interactive farm radio project across 4 African countries and records, across gender, the percentage of those implementing at least one of the promoted agricultural practices. The highest percentage reported was 78%, while the lowest was 40%. In this report, 75% is used as the effectiveness metric for the radio campaigns alternative as the following assumptions are made: the alternative I propose is similar to the projects studied in Hudson et al. (2017), so we can assume its effects on behavior take-up are similar across different geographies and farmer populations. However, we feel comfortable adapting one of its higher figures as the alternative proposed in this report includes a financial incentive for participation in listening groups that Hudson et al. (2017) did not employ, and because this alternative is proposed for a three-year period, while the former took place over 15 months, suggesting greater potential take-up.

Combining this data, the radio campaigns alternative cost-effectiveness is about **$175 per woman farmer taking up new behavior and $130 in cost per woman farmer reached.**

TECH. CAPABILITIES

The radio campaign alternative presents a distinct case under the tech. capabilities criterion. The radio possesses key characteristics that make it highly accessible. It can be delivered in an audio format in a local language, and as a longstanding staple of the limited, but present technology in rural contexts across the globe, India not excluded, it is seen as a highly trustworthy source of information, this information perceived as high-quality and locally relevant (Haworth et al., 2018). Beyond just its perception, too, radios have an undeniable case in their ease of use. Beyond an initial session with NGO personnel, we can be confident that technological literacy will not hamper radio usage (Hudson et al., 2017). However, this alternative is not favorable in its tailorability. Radios do not allow for interactive feedback and there are no search capacities involved with this traditional form of ICT. The information the farmers will receive under this alternative will be dictated by the NGO administering this program. For these reasons, this alternative is ranked as **"low" for its tech. capabilities.**

COMMUNAL LEARNING

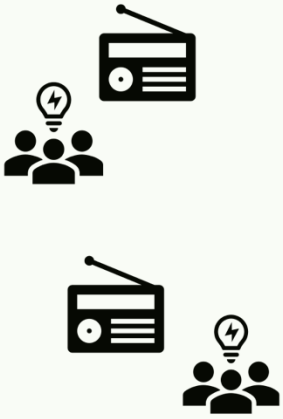
Radio campaign interventions have been designed to leverage the power of communal learning, and this alternative is no exception. Information is consumed via group listening sessions, in which farmers can interact with each other throughout, and following the end of a broadcast, a formal space for discussion of that session's information is held. This creates a cooperative environment in which shared learning takes place. Farmers can discuss how information directly relates to their individual farming activities with another, providing grounds for inspiration by brainstorming potential ways to apply the information they just received to new farming practices and hearing about the practices of other farmers. Studies show that this communal approach positively impacts listenership, knowledge, and initial adoption of new behaviors (Haworth et al., 2018; Hudson et al., 2017). For these reasons, this alternative is ranked as **"high" for communal learning.**

SCALABILITY

The radio campaigns alternative presents challenges in its scalability. The process of surveying a community, creating women listening groups, and rewarding financial incentives for participation is cheaper and more straightforward than the mobile phones alternative but still presents many logistical details that must be handled on a case by case basis. An agricultural expert would be required to create content for radio broadcasts and the alternative requires funding from a government or philanthropic source. This alternative is ranked **"medium" on scalability.**

Outcomes Matrix

Alternatives:



Criteria:	**Mobile Phones** (Mittal, 2020)	**Village Info Centers (VICs)** (e-Choupal, by ITC Ltd.)	**Radio Campaigns** (Hudson et al., 2017)
Cost-Effectiveness ($ per farmer changing behavior)	$250	**$80**	$170
Cost-per-head ($ per farmer reached	$200	**$70**	$130
Tech. Capabilities (low to high)	**high**	medium	low
Communal Learning (low to high)	low	**high**	**high**
Scalability (low to high)	low	**high**	medium

Recommendation

The recommended course of action is the **Village Information Centers** alternative. Evaluating the proposed alternatives under each criterion reveals the wide-ranging advantages and distinct features of VICs, and specifically, of the **e-Choupal.**

TRADEOFFS

In terms of cost-effectiveness and cost-per-head, the e-Choupal is the far most superior alternative. The intervention is unlike the other two in that it requires essentially one piece of technological hardware (a computer kiosk) and only one internet connection to serve 500 women, whereas the mobile phones alternative provides each of the 500 targeted women with a phone and service plan and the radio campaigns alternative provides 50 radios for its listening groups that it broadcasts a show to. Coming in at about $80 per farmer changing their behavior and $70 per farmer reached, the alternative is multiples cheaper than its counterparts.

A tradeoff certainly exists, however, with regards to this very fact. As the e-Choupal offers just one kiosk, its tech. capabilities are out-rivaled by the mobile phones alternative. Mobile phones enable farmers to receive information via text and audio messages and call an operator phone line to ask questions with the power of their fingertips. This proximity to information is buffered in the VIC alternative which presents some physical distance, about 5km, for farmers.

Yet, the advantages associated with this physical gathering space far outweigh its drawbacks. The trained women farmer, or sanchalak, operating the e-Choupal removes the barrier of technological literacy for each farmer by translating their asks into specific online queries. By then providing this information in a personable manner to farmers, its information is made greatly accessible. Furthermore, the physical gathering space of the e-Choupal and its participatory approach greatly enhances its communal learning. A collaborative setting shaped by input from the community itself in its design and implementation, information shared via the e-Choupal is suited for knowledge gain and adoption.

Finally, VIC is the definitive alternative in terms of scalability. ITC Limited has proven the success of the e-Choupal model through its expansion across 10 states of India with a total of 6,100 kiosks. Its services currently reach over 4 million farmers and with this know-how and experience, scaling up with additional women-focused centers is far more feasible than logistical work required of both the mobile phones and radio campaigns alternatives.

In conversations with experts at Dhwani Rural Information Systems, an impact organization that enables social enterprises by leveraging ICT solutions, the heterogeneity of the Indian landscape and the need for scalable interventions became clear: **"How can you create technology that can reach the masses, considering they are so diverse in language, literacy, education, and technical ability?"** (M. Rastogi, personal communication, March 28, 2023). While VICs are not without their challenges, there is great promise in adapting the e-Choupal to the broad range of female farmers in India who have historically remained on the sidelines of accessing critical information.

IMPLEMENTATION

Several implementation considerations and obstacles lie in the path forward to ultimately creating a women-focused e-Choupal. Key issues will involve Sattva Consulting first approaching ITC Limited to pitch this idea and gain their support. After this concept is agreed upon, putting it to practice will involve coordination across different actors to ensure the project's efficacy. Questions surrounding design, location and the process of surveying a community must be answered and thoroughly planned for in order to mitigate risks in the implementation phase and for the development of a promising pilot for future expansion.

Sattva can begin to move this recommendation forward by first approaching ITC Limited with a proposal to help them implement and pilot a women-focused e-Choupal. Focused on scalable solutions for social impact, Sattva is a leader in the Indian development sphere. The firm partners with social organizations, foundations, corporations, and philanthropists to achieve their social impact goals, and a project of this nature is well aligned with its scope and mission. ITC Limited is an Indian conglomerate with a presence in many sectors, including agribusiness. Currently, ITC administers women empowerment programs, such as one focusing on "Ultra Poor Women," which has reached over 54,000 women and develops their entrepreneurial skills (The Better India, 2018). While these initiatives are funded on a philanthropic basis and part of their corporate social responsibility (CSR) efforts, this proposed solution should not just be categorized as such. Sattva can emphasize to ITC that this project mirrors their existing e-Choupals, which are provided free of cost to users as it helps the firm source crops directly from farmers and save on their procurement costs (Zhou & Babu, 2015). It is difficult to imagine this new focus to an existing initiative warranting a tremendous amount of resistance on the behalf of ITC. However, in this case, Sattva can emphasize its leadership in the gender ecosystem and its past work that has made progress on inequities to illustrate the importance of the problem and the crucial role ITC can play in combatting informational deficits.

Once ITC is on board with the project's concept and its partnership with Sattva, other key stakeholders come into view and must be engaged properly to ensure effective implementation. First, design and location must be considered. The region and exact geographic locale where the e-Choupal will be placed should take into account where ITC has the logistical capabilities to transport and install necessary equipment. Also, of high importance, is selecting an area highly susceptible to the effects of climate change in which there is a need for relevant agricultural and weather information. After Sattva and ITC work to find this locale using both parties' expert knowledge, various other stakeholders come into play: the community itself, and field workers. In order to ensure this space is used by women farmers, its design must take into consideration the needs and preferences of women. Evidence shows including community members in the formulation and implementation stage of such interventions can greatly contribute to their take-up (Obayelu & Ogunlade, 2006). This is a critical stage in the implementation process with numerous challenges. Navigating them will be essential for the project's success.

To begin this process of community surveying, Sattva and ITC should work with a local agricultural NGO with relevant sectoral and regional experience. A field worker from this organization can work to build trust while speaking with community members and discussing the e-Choupal initiative with them by emphasizing the participatory approach of the project. By asking questions about individual needs and offering them the chance to voice what they would like to see in a village information center, the field worker can demonstrate the bottom-up nature of the initiative, a perception which has shown to impact adoption of new programs (Haworth et al., 2018). This stage is essential in designing an e-Choupal which will ultimately be used by the women farmers, the stakeholder group, it is intended to aid. Although there is not an expectation of explicit disapproval from this group, we can mitigate for this risk and gain support through planning and surveying. With buy-in from the local community, the VIC can work in the promotion of communal and shared learning (Babu et al., 2015)

Finally comes the process of installing the e-Choupal and training a women farmer, sanchalak, on its use. Execution at this phase can be expected with success by ITC who has created more than 6,100 centers across India (Senthilkumar et al., 2013). In order for this pilot to serve as a starting point for expansion of future women-focused centers, ITC can regularly have its team visit the site and report with the sanchalak to determine challenges and collect data on its use.

Over the course of the three-year pilot, Sattva and ITC can work to make plans on expansion to several other locations and formalize a standard procedure for scaling up. A great amount of potential exists with women focused e-Choupals and learning valuable design and implementation lessons will be critical for national expansion. Through demonstrating this proof of concept, Sattva and ITC can involve the public and philanthropic sectors in funding for future centers and truly achieve scale for the millions of women farmers without adequate access to information.

CONCLUSION

The effects of climate change are already being acutely felt by women farmers in India. These pressures will only rise as climate events worsen in intensity and frequency. As agriculture grows increasingly knowledge intensive under climatic pressures, information becomes of critical importance. Information on weather, crop patterns, pest outbreaks, crop prices, and climate smart adaptation practices has immense value to the women farmer who must make decisions with constrained resources. These women, however, are among the most information deprived, facing critical information deficits across dimensions of agriculture extension services, the internet, and mobile and smart phone.

Amidst a burgeoning information era, critical tools have emerged that can disseminate information to women: Information Communication Technologies (ICTs). These technologies take advantage of precipitating data and hardware costs and an increasingly connected environment. While vast research has been conducted on the efficacy of these ICTs in the agricultural sphere, much of it ignores the gender lens.

This report proposes and analyzes the viability of three women-focused ICT interventions: mobile phones, Village Information Centers (VICs), and radio campaigns. After assessing the proposed alternatives under evaluative criteria, it provides the recommendation of pursuing VICs, specifically, a women-focused e-Choupal.

There is great promise in adapting the e-Choupal to the female farmer who has historically remained on the sidelines of accessing critical information. Ultimately, information alone cannot alleviate the myriad burdens women farmers face in India. However, it is a critical first step of many that can empower the female farmer and bolster their adaptive capacities in light of climate change.

APPENDIX

APPENDIX A.

Appendix A. provides the motivation for each criterion, and factors for how they are operationalized and measured

CRITERIA 1.) COST-EFFECTIVENESS

Potential interventions must be able to demonstrate efficiency within a context where funds for programs are limited and establishing proof-of-concept is critical. This criterion will compare each alternative in terms of the dollars spent per woman farmer changing their behavior, a proxy demonstrating their increased adaptive capacity.

To operationalize this cost-effectiveness metric, the costs of each alternative must be fully charted. This includes evaluating the costs of the technology each ICT intervention provides in terms of both their hardware and software. Hardware costs would include the physical piece of technology and associated accessories, such as batteries and cables, along with software costs, like the price of data, text/voice functionality, and any online service or portal being utilized and their associated licensing price. Further, with each intervention comes implementation and organizational costs that require the use personnel for training women farmers on how to use the ICT, program administration, including the cost of content creation if required, maintenance of the technology, and monitoring and evaluation of ICT use.

On the effectiveness side of this criterion, the ability of each alternative in changing women farmers' behavior will be evaluated. To operationalize this, I plan to conduct a thorough review of the literature in which ICT interventions, closely akin to those that I propose, examine the impact of information delivery on take-up of a new behavior. These behavior changes may be new farming practices, such as procuring and planting a drought-resistant strain of rice. Following this review, I will apply the quantitative data on behavior take-up to my alternatives by making a series of assumptions: the alternatives I propose are similar in nature to the ICT interventions studied in the literature, so we can assume their effects on behavior take-up are similar across different geographies and farmer populations; and we assume that the behavior change found, represents a benefit to the farmer that helps to bolster their adaptive capacity to climate change.

CRITERIA 2.) COST PER-HEAD

Both the literature and experts are aligned in viewing information as of intrinsic benefit for farmers and especially for women, who currently face many informational deficits. Information increases women farmers' knowledge While difficulties exist in causally tracing the impact of information on material outcomes, it is an empowering tool that is worthy of consideration on this basis alone (Mittal, 2020).

This criterion will convey the reach of each alternative in terms of their cost per the number of women they deliver information to, by dividing total cost per woman farmer reached. This criterion is valuable to consider in addition to a cost-effectiveness metric for multiple reasons -- first of which is that ICT interventions can be very inexpensive in the information era of increasingly cheap technology and data costs. Secondly, removing the lens of effectiveness for analysis of these alternatives is fruitful because of the difficulties associated with tracing the impact of information delivery to material outcomes for women farmers. Other environmental factors make it challenging to isolate the effect of information, and attempts to do so rest upon assumptions attempting to establish a causal chain of impact. By solely showing the cost per-head of each intervention, we are not bound to these assumptions, and can demonstrate the efficiency of ICTs.

Criteria 3.) Tech. Capabilities

The technological capabilities of each ICT intervention are critical to evaluate. This criterion will consider the technological capabilities of the proposed ICT alternatives. It will be operationalized by evaluating ICT features that influence the ability of the user to both access and tailor the information provided to their needs. Across these dimensions of accessibility and tailorability, a host of different factors will be considered for each ICT: the ability to search for information as it relates to individualized farming activities, the capacity for participant feedback through interactive functionality, the degree to which information can be locally relevant, the medium with which information is disseminated (written or spoken), the number of available languages, and the level of technological know-how needed, or its ease of use.

Criteria 4.) Communal Learning

This criterion will explore the ability of the proposed alternatives to promote communal learning among the women farmers they hope to target. The literature provides evidence that communal approaches for informational interventions positively impact knowledge gain and initial adoption of new behaviors (Haworth et al., 2018; Hudson et al., 2017). This will be operationalized by investigating factors for each alternative's design and implementation that relate to communal learning: the opportunity each ICT allows for the shared consumption of information, peer to peer communication capabilities, space for discussion of information and its implications, and participatory approaches that involve women farmers in the design of programs.

Criteria 5.) Scalability

Critical to evaluate will be the ease with which each alternative can be scaled as the defined problem exists at an immense scale across different regions of India. As such, this criterion will consider the scalability of the proposed alternatives. Solutions, however, must be administered at and adapted to the local environment and its needs. The factors by which the ability to scale will be analyzed by are: the number of staff needed to implement, the required expertise or training of the staff, the number of agencies needed to be involved, the length of the implementation process, and the nature of the funding sources for each alternative.

APPENDIX B.

Appendix B. provides the cost and cost-effectiveness calculations for each alternative

COST CALCULATIONS OF ALTERNATIVE 1.) MOBILE PHONES

Cost (USD 2023)	Year 1	Year 2	Year 3
Hardware			
Phone (includes SIM and charger)	$ 15,000.00	0	0
Software			
Service Fee	$ 11,700.00	$ 11,700.00	$ 11,700.00
Program/Personnel			
Surveying of Community	$ 160.00	0	0
Promotional/Educational Campaign	$ 300.00	0	0
Distributing Phones and Training	$ 160.00	0	0
Full Time Positon	$ 18,000.00	$ 18,000.00	$ 18,000.00
Content Creation	-	-	-
Operator Phone Line	-	-	-
Maintenance Costs	-	-	-
Administration & Operating Costs	-	-	-
Monitoring & Evaluation	-	-	-
		NPV (USD 2023)	
Per Year Total	$ 45,320.00	$ 28,834.95	$ 27,995.10
Total Cost for Implementing over 3 Years	$ 102,150.05		

Effectiveness	
Women Farmers Reached	500
Effectiveness in behavior change (%)	83%
# of Women Farmers taking up new behavi	415

Cost-Effectiveness	
Cost per women farmer changing behavi	$ 246.14
Cost per women farmer reached	$ 204.30

This alternative adapts the effectiveness metric from Mittal (2016), stating, "83.3 percent of women farmers who were engaged in farming reported having taken action on the information they received."

For cost of a mobile phone, it uses Mobal's BLU Zoey 2.4 3G model, listed at $30 per unit (Mobal, 2023).

For cost of service fee, it uses Airtel's 28-day, $1.80 plan (Selectra, 2023).

For program and personnel costs, it uses the following assumptions and calculations:

Required Hours of labor			Labor	Assumptions:	Average NGO Salary:
		80 hours	Volunteer labor	Two weeks to survey community and agricultural practices	Rs 26,000 month
		40 hours, promotional materials	Volunteer labor	One week to promote intervention	Rs 6,500 week
		80 hours	Volunteer labor	Two weeks to distribute and provide training	$80 / week
	Full Time Position				
		12 hours per week	1 Full time staff positon for enumerated activities		
		8 hours per week	Program administered by agricultural expert working for suitable NGO sector wage, Project Manager		
		6 hours per week	Experienced Agriculture Project Manager salary:		
		8 hours per week	Rs 1,500,000/year $18,000/year		
		6 hours per week	https://in.indeed.com/jobs?q=ngo+agriculture+₹4%2C80%2C000&vjk=82c1b16c9c729680		

COST CALCULATIONS OF ALTERNATIVE 2.) VILLAGE INFORMATION CENTERS

Cost (USD 2023)	Year 1	Year 2	Year 3
e-Choupal			
Set up	$ 10,000.00	0	0
Dial-up connectivity	$ 800.00	0	0
Commission earned by Sanchalak	$ 6,000.00	$ 6,000.00	$ 6,000.00
Support and Maintenance (training, equipment repairs, software bugs)	$ 164.00	$ 164.00	$ 164.00
Costs incurred by Sanchalak			
Operational costs (electricity and internet)	$ 260.00	$ 260.00	$ 260.00
Labor (operating e-Choupal)	$ 1,100.00	$ 1,100.00	$ 1,100.00
Program Launch			
Surveying of Community	$ 160.00	0	0
Promotional/Educational Campaign	$ 300.00	0	0
	NPV (USD 2023)		
Per Year Total	$ 18,784.00	$ 7,304.85	$ 7,092.09
Total Cost for Implementing over 3 Years	$ 33,180.95		
Effectiveness			
Women Farmers Reached	500		
Effectiveness in behavior change (%)	86%		
# of Women Farmers taking up new behavior	430		
Cost-Effectiveness			
Cost per women farmer changing behavior	$ 77.16		
Cost per women farmer reached	$ 66.36		

This alternative adapts the effectiveness metric from Madan et al. (2012) stating, “"6% participants said [e-Choupal's] had a large influence in ability to analyze own situation and solve problems."

For scaling up costs from 2003 to 2003, it uses the cumulative inflation rate of 63.50%

It uses the following figures for set-up, connectivity, commission and support and maintenance:

(Anupindi, 2003)	"Each e-Choupal costs between US$3,000 and US$6,000 to set up"			Conservative estimate: $6,000 (2003)		$10,000 (2023)	
(World Bank, 2003)	"An investment of Rs 40,000 is needed to establish an e-choupal with dial-up connectivity."				Rs 40,000 =	$485 (2003)	$800 (2023)
(Anupindi, 2003)	"This year, he has earned [$300] in one month."	x12 months =	$3,600 (2003)	$6,000 (2023)			
(World Bank, 2003)	"ITC spends an average of Rs 5,000 (US$100) annually on the support and maintenance of each e-choupal.						
	$100 (2003)	$164 (2023)					

It uses the following figures for operational and labor costs incurred by the Sanchalak:

(World Bank, 2003)	"The sanchalak pays for day-to-day operational costs, such as electricity and Internet charges. These costs vary from Rs 3,000 to Rs 8,000 (US$60 to US$160) per year.					
				Conservative estimate: $160 (2003)		$260 (2023)
(Raman, Devi 2021)	Day of farm work for women ranges from (Rs 50-250)		Conservative estimate: Rs 250/day			
			Rs 91,250/year	$1, 100/year		

For labor costs it uses the following figures:

Required Hours of labor		Assumptions:	Average NGO Salary:
80 hours	Volunteer labor	Two weeks to survey community and agricultural practices	26,000 Rs/month
40 hours, promotional materials	Volunteer labor	One week to promote intervention	6,500 Rs/week
			$80 / week

Cost Calculations of alternative 3.) Radio campaigns

Cost (USD 2023)	Year 1	Year 2	Year 3
Hardware			
Radio	$ 850.00	0	0
Batteries	$ 100.00	$ 100.00	$ 100.00
Participation			
Financial Incentive	$ 3,900.00	$ 3,900.00	$ 3,900.00
Program/Personnel			
Surveying of Community	$ 160.00	0	0
Promotional/Educational Campaign	$ 300.00	0	0
Distributing Radios and Training	$ 80.00	0	0
Full Time Positon	$ 18,000.00	$ 18,000.00	$ 18,000.00
Content Creation	-	-	-
Maintenance Costs	-	-	-
Administration & Operating Costs	-	-	-
Monitoring & Evaluation	-	-	-
		NPV (USD 2023)	
Per Year Total	$ 23,390.00	$ 21,359.22	$ 20,737.11
Total Cost for Implementing over 3 Years	$ 65,486.33		
Effectiveness			
Women Farmers Reached	500		
Effectiveness in behavior change (%)	75%		
# of Women Farmers taking up new behavior	375		
Cost-Effectiveness			
Cost per women farmer changing behavior	$ 174.63		
Cost per women farmer reached	$ 130.97		

This alternative adapts the effectiveness metric from Hudson et al. (2017) stating, "Percentage of listening and non-listening female and male respondents who implemented at least one of the promoted practices in the Interactive Farm Radio Services project," assuming 75% as discussed in the text of the report under the Findings section.

For cost of a mobile phone, it uses Philip's Radio DL 167/94 model, listed at $17 per unit (Philips, 2023).

For cost of batteries, it uses Energizer's Max AAA at $2 per 6 pack, with 52 hour usage per year calling for 6 batteries per year plan for 50 listening groups (Energizer, 2023).

For financial incentives it uses a half day's wage worth of farm work under the following calculations:

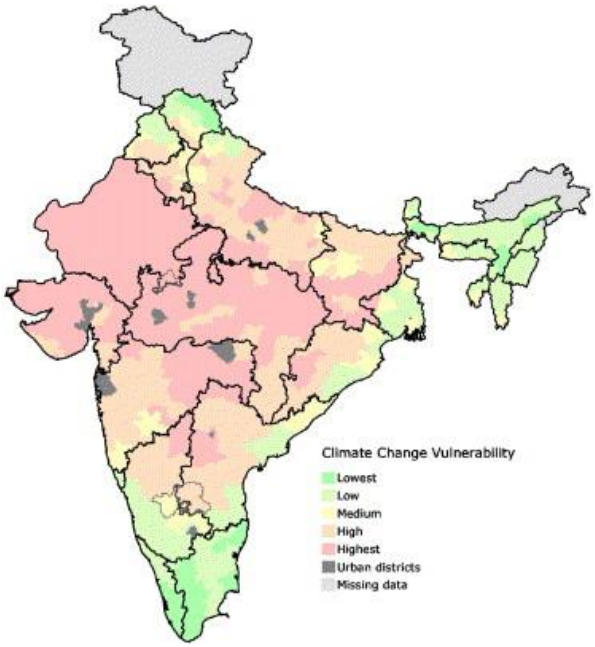
Cash payments	Rs 25 ($0.30)	Rewarded at 2 sessions of 4 per month	26 payments / year	500 women	Day of farm work for women ranges from (Rs 50-250)
		https://www.indiaspend.com/agriculture/why-women-farmers-are-losing-jobs-earnings-savings-even-as-agriculture-booms-773953			

For program and personnel costs, it uses the following assumptions and calculations:

Required Hours of labor	Program Launch	Labor	Assumptions:	Average NGO Salary:
	80 hours	Volunteer labor	Two weeks to survey community and agricultural pra	Rs 26,000 month
	40 hours, promotional material	Volunteer labor	One week to promote intervention	Rs 6,500 week
	40 hours	Volunteer labor	One week to distribute and provide training	$80 / week
	25 hours per week	1 Full time staff positon for enumerated activities		
	5 hours per week	Program administered by agricultural expert working for suitable NGO sector wage, Project Manager		
	5 hours per week	Experienced Agriculture Project Manager salary:		
	5 hours per week	Rs 1,500,000/year	$18,000/year	
		https://in.indeed.com/jobs?q=ngo+agriculture+₹4%2C80%2C000&vjk=82c1b16c9c729680		

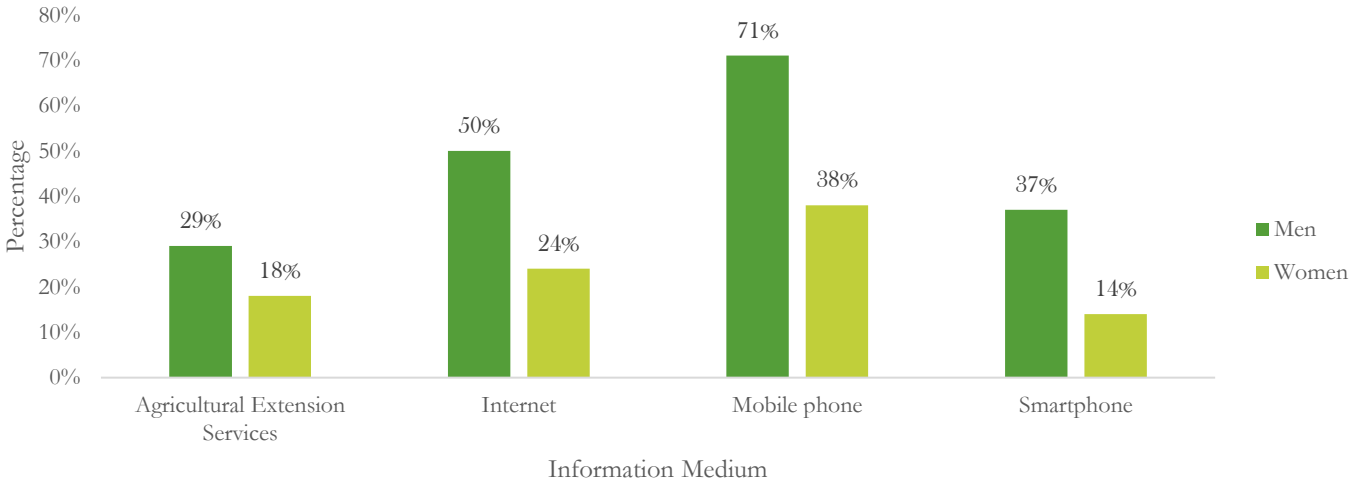
FIGURES

FIGURE A. CLIMATE CHANGE VULNERABILITY



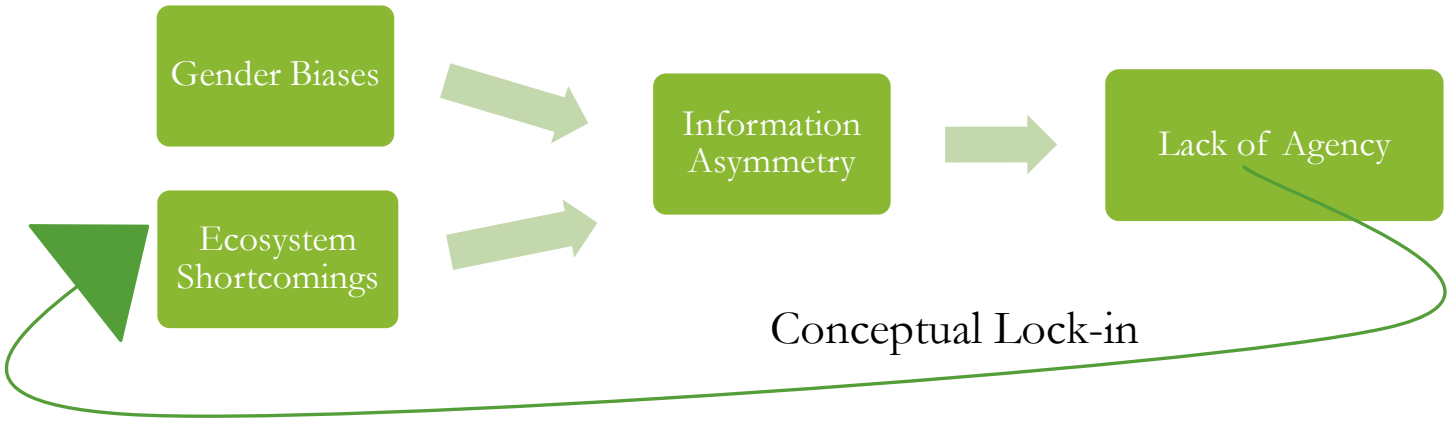
Source: (O'Brien at al., 2014)

FIGURE B. INFORMATION ASYMMETRY



Source: (GSMA, 2020; Iftikhar, 2021; Jha, 2022; Shah, 2018)

FIGURE C. CONCEPTUAL LOCK-IN



Source: (Aryal et al., 2014)

FIGURE D. CONSEQUENCES OF CLIMATE CHANGE

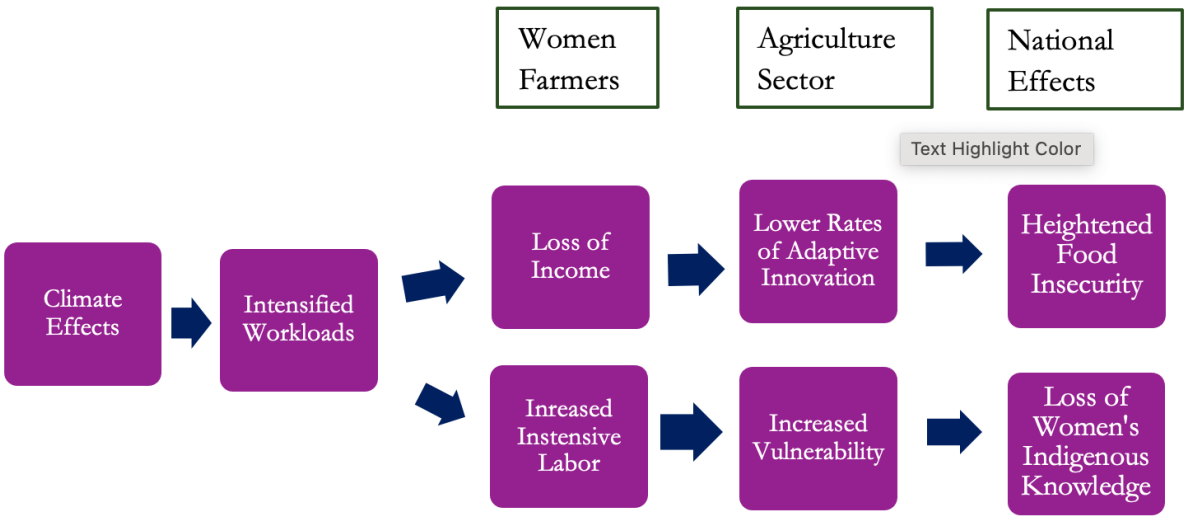
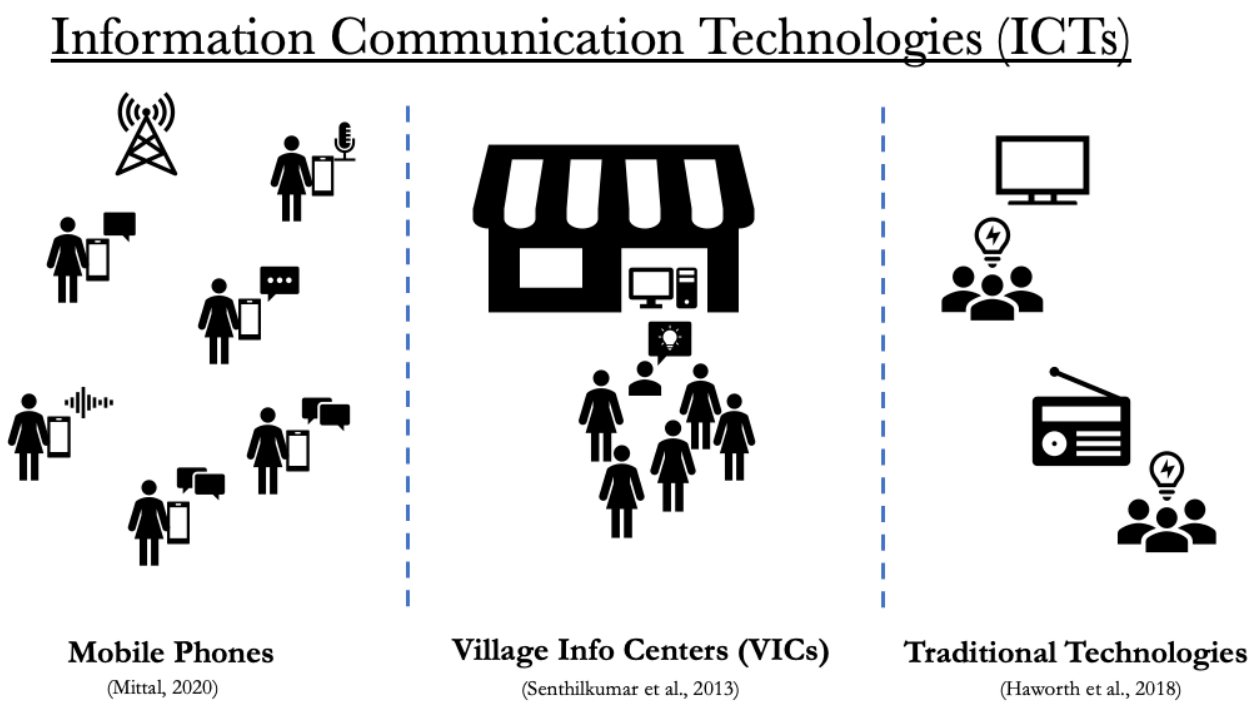


FIGURE E. MODALITIES OF ICT INTERVENTIONS



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